AN ANALYSIS OF THE SCOPE AND QUALITY OF THE CURRENT SUPPLY OF EDUCATIONAL SOFTWARE, AND OF THE AVAILABLE SOURCES OF INFORMATION ON EDUCATIONAL SOFTWARE

by

Ellen R. Bialo and Jay P. Sivin
Interactive Educational Systems Design, Inc.

September 30, 1987

This document was prepared under a contract with the Office of Technology Assessment, Congress of the United States, for the assessment, *Power On: New Tools for Teaching and Learning*. The conclusions are those of the authors. The document does not necessarily reflect the analytical findings of OTA, the Advisory Panel, or the Technology Assessment Board.

J952-26

AN ANALYSIS OF THE SCOPE AND QUALITY OF THE CURRENT SUPPLY OF EDUCATIONAL SOFTWARE, AND OF THE AVAILABLE SOURCES OF INFORMATION ON EDUCATIONAL SOFTWARE

CONSULTANTS

Robert Haven
Educational Products Information Exchange (EPIE) Institute

Mark Sherry
MicroEase, Inc.

George Sullivan
Information and Learning Technologies Division,
The Academy for Educational Development

AN ANALYSIS OF THE SCOPE AND QUALITY OF THE CURRENT SUPPLY OF EDUCATIONAL SOFTWARE, AND OF THE AVAILABLE SOURCES OF INFORMATION ON EDUCATIONAL SOFTWARE

TABLE OF CONTENTS

Introduction 1

Chapter I. Scope of the Current Supply of Educational Software 2

Chapter II. Assessment of Educational Software Quality 27

Chapter III. Educational Software Information Sources: How They Are Perceived and Used by Acquisition Decisionmakers 32

Appendix I. A Comparison of the Three Databases Used for This Study I-1

Appendix II. Comparison of *The Educational Software Selector* (TESS) and *The Microcomputer Software and Hardware Guide* (MSHG) Databases: Distribution of Programs by Cost II-1

Appendix III. Sampling Strategy for Collection of Data from States Concerning "School Need" III-1

Appendix IV. Procedure for Determining High Quality Software IV-1

Appendix V. A Summary of Responses from Interviews with Heads of Educational Software Evaluation Agencies to Ascertain a Picture of their Processes V-1

Appendix VI. A Summary of Responses from Interviews with Software Acquisition Decisionmakers to Ascertain their Views on Various Information Sources VI-1

Appendix VII. Licensing and Leasing, Field Testing, and Previewing VII-1

INTRODUCTION

In this report, we present an analysis of the scope and quality of the current supply of educational software, as well as an analysis of the information sources available to educational software acquisition decisionmakers.

The report is divided into three chapters. In Chapter I, we examine the distribution of the available supply of educational software with respect to school subject, areas within subjects, grade range, type, computer family and cost. These data are then compared to an assessment of "school need" based on information from a sample of State Departments of Education, national-level reports on education, and firms that consult with the educational software industry.

In Chapter II, we assess the quality of the existing supply of software, based on evaluations from eight of the more thorough software evaluation agencies. In order to explore trends in software quality, programs with pre-1985 copyright dates are compared to programs with 1985-1987 copyright dates. Finally, the results of this software quality assessment are compared with the judgments of "leading edge" teachers.

We have not explored the scope and quality of educational software provided via computer networking systems, such as MICAT and WASATCH. These systems typically offer sophisticated management and recordkeeping capabilities, as well as proprietary courseware. The networks are not all alike. Some systems also offer third-party software; others do not. Some utilize standard microcomputers as the end terminals, thereby allowing schools to use stand-alone third-party software; some do not. Some of the proprietary software offered by these systems is highly interactive and makes excellent use of the computer's capabilities; some of the courseware is unimpressive. An important issue for educational consumers relative to these systems is cost; the price of the system may prohibit some schools from considering purchase of stand-alone software. Unfortunately for our purposes, the proprietary software offered via these systems is rarely included in independent courseware directories or reviewed by independent evaluation agencies. Since independent directories and evaluations were the prime sources of data for this study, the networks' proprietary courseware could not be included in the analysis.

In Chapter III, we present a typology of sources that offer information about educational software. This typology takes into consideration the needs of software acquisition decisionmakers at the state, district,and local levels, as well as the information actually provided by various sources. The typology assesses how useful each source type is likely to be to decisionmakers, as well as how accessible each is likely to be. Suggestions for a government role in disseminating information on educational software are provided.

CHAPTER I

SCOPE OF THE CURRENT SUPPLY OF EDUCATIONAL SOFTWARE

OVERVIEW

In this chapter, we compare the overall distribution of the current supply of educational software with areas of school need identified by a variety of sources.

The data on the overall distribution of software comes from *The Educational Software Selector* (TESS) database, available through the Educational Products Information Exchange (EPIE) Institute, containing data current as of July 1987. This database contains the most current and complete information available about educational software and is representative of the overall software market. It contains 7,325 software programs representing roughly 80-85% of all educational software used directly with students, divided among 21 subject categories.[1]

In order to identify school needs that might be satisfied by educational software, we collected data from states, national-level reports and firms that consult to the educational software industry.

DATA ON THE SCOPE OF THE CURRENT SUPPLY OF EDUCATIONAL SOFTWARE

Distribution of Software by Subject

The larger percentages of software fall within the major school subjects including Mathematics (27%), Science (16%), English/Language Arts (12%), Reading (12%), and Social Science (8%). Most of the non-major subject categories include less than 5% of the software. Within the non-major subjects, only three included 5% or more of the software: Comprehensive (6%), Computers (5%), and Foreign Language (5%).

Table 1 presents the percentage of software programs by subject, rounded to the nearest unit. Figure 1 presents these percentages in graph form.

Distribution of Major Subject Programs by Area

Table 2 represents the distribution of Reading programs by area. The largest percentage of programs is in Vocabulary (38%) followed by Comprehension Skills (24%). The smallest percentage of programs is in Reading in Content Areas (6%), an area that may be underserved by the marketplace.

---

1. For purposes of comparison, two other databases, *.MENU -- The International Software Database* (.MENU), by the International Software Database Corporation, and the *Microcomputer Software and Hardware Guide* (MSHG) database, by R.R. Bowker, accessible via DIALOG, were also searched utilizing subjects identified in the TESS database. (Appendix I contains the results of these comparisons.)

TABLE 1. DISTRIBUTION OF PROGRAMS BY SUBJECT (N=7325)

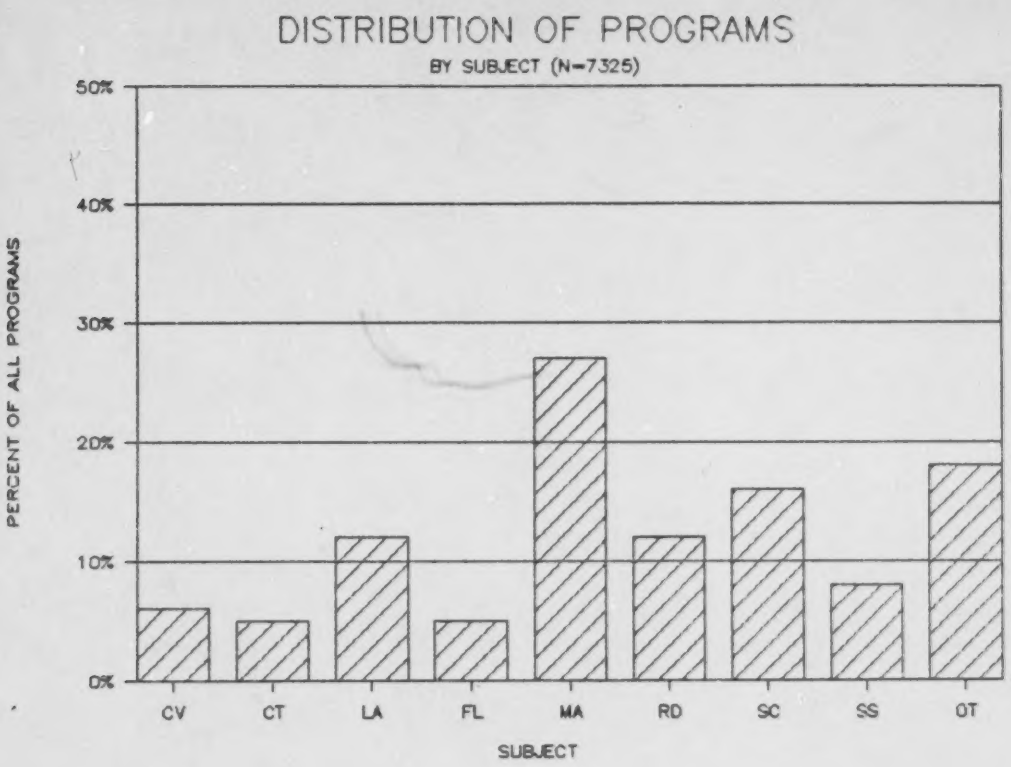
	Percent of Programs*	No. of Programs*
Comprehensive (CV)	6%	427
Computers (CT)	5%	331
ENG/LARTS (LA)	12%	894
For Lang (FL)	5%	356
MATHEMATICS (MA)	27%	1971
READING (RD)	12%	869
SCIENCE (SC)	16%	1148
SOC SCI (SS)	8%	565
Other (OT)**	18%	1329

* The sum of the programs in each subject category is greater than N due to the fact that some programs are assigned to more than one subject category. Accordingly, the total of the percentages is greater than 100%. All percentages were rounded to the nearest unit.

** The *Other* category combines 13 subjects (Agriculture, Aviation, Business, Driver Education, Early Learning/Preschool, Fine Arts, Guidance, Health, Home Economics, Industrial Arts, Library Skills, Logic/Problem Solving, and Physical Education), each of which accounts for less than 4% of the total number of programs.

Source: Educational Products Information Exchange (EPIE) Institute, The Educational Software Selector (TESS) Online, (Water Mill, New York: Unpublished, in-house version updated through July 1987).

FIGURE 1



Source: Educational Products Information Exchange (EPIE) Institute, The Educational Software Selector (TESS) Online, (Water Mill, New York: Unpublished, in-house version updated through July 1987).

TABLE 2. DISTRIBUTION OF READING PROGRAMS BY AREA (N=869)

	Percent of Programs*	No. of Programs*
Comprehension Skills	24%	210
Decoding Skills	10%	87
Reading in Content Areas	6%	54
Reading Readiness	20%	174
Vocabulary	38%	333

* The sum of the programs in each area category is less than N, due to the fact that some programs would not fit any of the area categories. Accordingly, the total of the percentages is less than 100%. All percentages were rounded to the nearest unit.

Source: Educational Products Information Exchange (EPIE) Institute, The Educational Software Selector (TESS) Online, (Water Mill, New York: Unpublished, in-house version updated through July 1987).

Table 3 represents the distribution of English/Language Arts programs by area. The vast majority of programs are in Basic Skills (88%). The two remaining areas, Literature and ESL, each representing only 6% of the English/Language Arts software, appear to be inadequately served.

Table 4 represents the distribution of Mathematics programs by area. Almost three-quarters of the programs are in the Basic Skills area. All other areas represent less than 6% each, with the exception of Algebra (10%) and Geometry (6%). These figures may indicate the need for additional software for the more advanced areas of Mathematics, especially those more commonly taught (e.g., Trigonometry, Statistics).

Table 5 represents the distribution of Science programs by area. Those with the most programs are Physics (22%), Chemistry (21%), Biology (18%), and General Science (12%), courses commonly taught at the high school level. One important area that stands out as particularly low is Scientific Methods (3%). Other areas containing low percentages of programs (e.g., Zoology) are not commonly taught.

Table 6 represents the distribution of Social Science programs by area. Areas most commonly taught in schools have the highest percentages of software: History (34%), Geography (25%), and Basic Skills (13%), which includes interpreting charts and graphs, and locating and organizing information.

Distribution of Programs
by Subject Within Grade Ranges

In order to examine the distribution of software by subject within grade ranges (i.e., kindergarten, and grades 1-3, 4-6, 7-8, and 9-12), percentages of programs by subject are calculated for each grade range. These percentages are presented in Table 7.

The greatest percentages of Kindergarten software fall within Reading (33%), Early Learning/Preschool (25%), and Mathematics (20%), the most important subjects addressed at this level.

For grades 1-3, the majority of the programs fall within Reading (28%), Mathematics (22%), and English/Language Arts (21%), again the most important subjects addressed at this level.

Examining the data for grades 4-6, Mathematics has the highest percentage of programs (24%), followed closely by English/Language Arts (20%) and Reading (17%). Note that only 9% of the programs are in the Science category, a subject that may be underserved by the marketplace at this grade level.

For grades 7-8 and 9-12, the highest percentages of programs fall within the major school subjects, with the exception of Reading. This is as expected, since the emphasis on Reading is greater in grades K-6. The percentage of Science programs increases from 13% in grades 7-8 to 23% in grades 9-12. Less than 10% of the programs in grades 9-12 are categorized as Social Science, which suggests that this subject may be underserved in high school by the software market. As grade range increases, there are more programs in a greater variety of subjects, including Foreign Language and Business. Figure 2 shows how the distribution of programs for major subjects varies from grade range to grade range.

TABLE 3. DISTRIBUTION OF LANGUAGE ARTS PROGRAMS BY AREA (N=894)

	Percent of Programs*	No. of Programs*
Basic Skills	88%	790
Literature	6%	51
ESL	6%	55

* The sum of the programs in each area category is greater than N due to the fact that some programs were assigned to more than one area category. Nonetheless, the total of the percentages is still equal to 100%, since all percentages were rounded to the nearest unit.

Source: Educational Products Information Exchange (EPIE) Institute, The Educational Software Selector (TESS) Online, (Water Mill, New York: Unpublished, in-house version updated through July 1987).

TABLE 4. DISTRIBUTION OF MATHEMATICS PROGRAMS BY AREA (N=1971)

	Percent of Programs*	No. of Programs*
Basic Skills	72%	1425
Algebra	10%	201
Geometry	6%	123
Other**	11%	225

* The sum of the programs in each area category is greater than N due to the fact that some programs were assigned to more than one area category. Nonetheless, the total of the percentages is still equal to 100%, since all percentages were rounded to the nearest unit.

** The *Other* category combines 10 areas (Analysis, Calculus, Consumer Mathematics, Differential Equations, Finite Mathematics, General Mathematics, Number Theory, Probability, Statistics, and Trigonometry), each of which accounts for less than 4% of the total number of programs.

Source: Educational Products Information Exchange (EPIE) Institute, The Educational Software Selector (TESS) Online, (Water Mill, New York: Unpublished, in-house version updated through July 1987).

TABLE 5. DISTRIBUTION OF SCIENCE PROGRAMS BY AREA (N=1148)

	Percent of Programs*	No. of Programs*
Anatomy and Physiology	4%	44
Astronomy	4%	44
Biology	18%	209
Chemistry	21%	241
Earth Science	8%	90
Ecology/Environment	4%	50
General Science	12%	143
Physical Science	4%	45
Physics	22%	250
Other**	10%	114

* The sum of the programs in each area category is greater than N due to the fact that some programs were assigned to more than one area category. Nonetheless, the total of the percentages is still equal to 100%, since all percentages were rounded to the nearest unit.

** The *Other* category combines 8 areas (Basic Skills, Geology, Meteorology, Natural History, Oceanography, Scientific Methods, Technology Education, and Zoology), each of which accounts for less than 4% of the total number of programs.

Source: Educational Products Information Exchange (EPIE) Institute, The Educational Software Selector (TESS) Online, (Water Mill, New York: Unpublished, in-house version updated through July 1987).

TABLE 6. DISTRIBUTION OF SOCIAL SCIENCE PROGRAMS BY AREA (N=565)

	Percent of Programs*	No. of Programs*
Basic Skills	13%	73
Civics/Government	6%	35
Economics	7%	39
Elementary Social Studies	4%	25
Geography	25%	143
History	34%	192
Political Science	4%	21
Psychology**	5%	27
Other***	3%	21

* The sum of the programs in each area category is greater than N due to the fact that some programs were assigned to more than one area category. Nonetheless, the total of the percentages is still equal to 100%, since all percentages were rounded to the nearest unit.

** The actual number and percentage of Psychology programs was unavailable due to computer error. The values presented here represent estimates.

*** The *Other* category combines two areas (Law and Sociology), each of which accounts for less than 4% of the total number of programs.

Source: Educational Products Information Exchange (EPIE) Institute, The Educational Software Selector (TESS) Online, (Water Mill, New York: Unpublished, in-house version updated through July 1987).

TABLE 7. DISTRIBUTION OF PROGRAMS
BY SUBJECT WITHIN GRADE RANGES

	GRADE RANGE				
SUBJECT	K*	1-3*	4-6*	7-8*	9-12*
Business	0%	1%	2%	3%	5%
	1	16	61	106	205
Comprehensive	7%	5%	5%	6%	8%
	41	86	167	224	363
Computers	5%	3%	4%	6%	7%
	27	61	131	209	294
Early Lrn/Pre	25%	8%	0%	0%	0%
	146	139	11	2	0
ENG/LARTS	8%	21%	20%	15%	10%
	45	373	646	532	462
Fine Arts	5%	4%	4%	4%	3%
	32	81	143	144	145
For Lang	1%	2%	4%	7%	8%
	4	29	134	264	343
Home Ec	0%	0%	2%	3%	4%
	0	5	57	125	176
Logic/Prob Sol	1%	3%	4%	3%	2%
	8	58	122	115	97
MATHEMATICS	20%	22%	24%	22%	17%
	115	402	775	807	767
READING	33%	28%	17%	9%	6%
	192	511	545	334	279
SCIENCE	1%	4%	9%	13%	23%
	4	70	275	451	1031

TABLE 7. DISTRIBUTION OF PROGRAMS
BY SUBJECT WITHIN GRADE RANGES (con't)

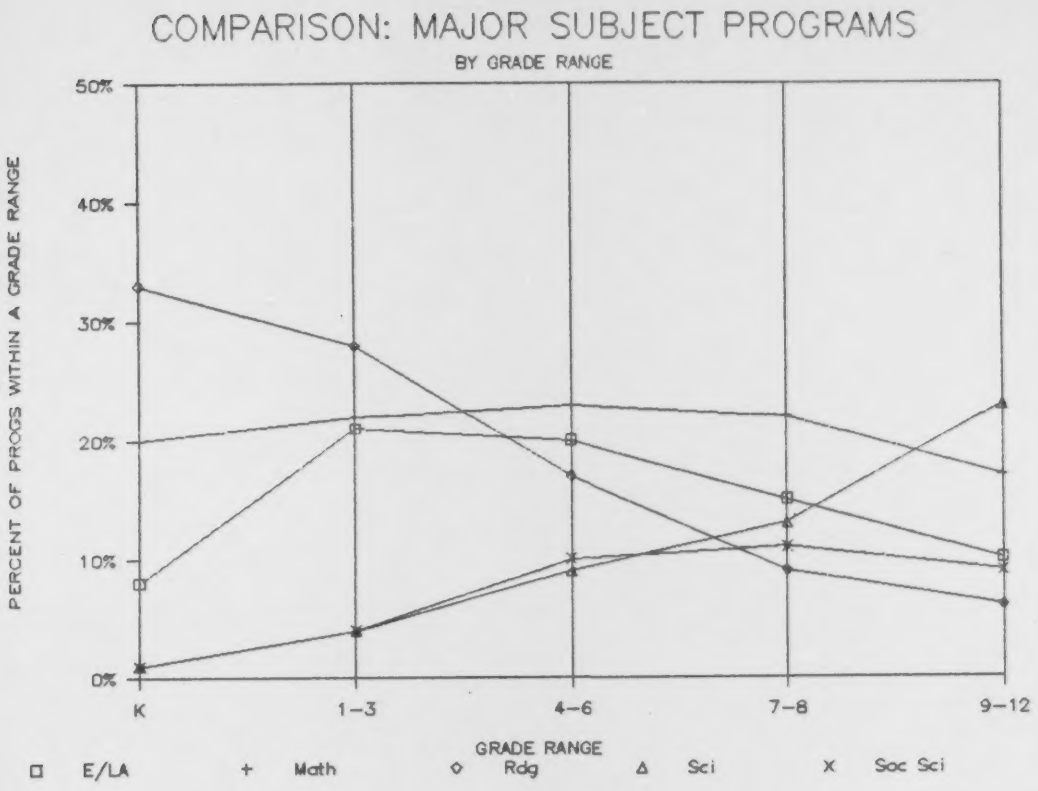
	GRADE RANGE				
SUBJECT	K*	1-3*	4-6*	7-8*	9-12*
SOC SCI	1% 5	4% 75	10% 313	11% 398	9% 404
Other**	<1% 1	2% 40	4% 116	6% 208	8% 357
Total Programs	589	1805	3234	3603	4514

* In each grade range column, a percent represents the percent of all programs in that grade range. The number below each percent represents the actual number of programs for that subject and grade range. All percentages were rounded to the nearest unit.

** The *Other* category combines 8 subjects (Agriculture, Aviation, Driver Education, Guidance, Health, Industrial Arts, Library Skills, and Physical Education), each of which accounts for less than 4% of the total number of programs in each grade range.

Source: Educational Products Information Exchange (EPIE) Institute, The Educational Software Selector (TESS) Online, (Water Mill, New York: Unpublished, in-house version updated through July 1987).

FIGURE 2



Source: Educational Products Information Exchange (EPIE) Institute, The Educational Software Selector (TESS) Online, (Water Mill, New York: Unpublished, in-house version updated through July 1987).

Distribution of Programs
by Copyright Date Range

Copyright dates are available for 3,655 software programs (approximately half). This information is provided by the publisher or taken from the actual program package if available. However, for approximately half of the programs, no copyright information is provided. One possible explanation for this is that software publishers believe that consumers are disinterested in such copyright information. An alternative explanation is that there is often a great lag between the date many programs are copyrighted and the date they are released; some publishers may seek to hide the age of their programs.

The 3,655 programs that do have copyright dates were divided between two date ranges, pre-1985 and 1985-1987, in order to assess trends in software production. There are 2,445 software programs that have a pre-1985 copyright date and 1,210 programs with a 1985-1987 copyright date. The difference in sample size may be due to the number of years included in each date range. Pre-1985 includes programs covering a period of approximately six years, whereas 1985-1987 includes programs covering a period of two and a half years. It should be noted that programs no longer available on the market are not included in the database used for this study.

Trends in Distribution by Subject

For each date range, we calculated the percentage of programs in each school subject out of the total number of programs in that date range, so that we could compare the distributions. Figure 3 shows the distribution of major subject programs for each copyright date range.

The percentage in each major school subject (English/Language Arts, Reading, Mathematics, Science, and Social Science) varies less than 5% between the two date ranges. For the non-major school subject categories, only the percentage of Comprehensive programs increased more than 5% from pre-1985 to 1985-1987. This category includes non-subject-specific tools, such as wordprocessors and database programs, which can be used across the curriculum and have, thus, become quite popular. The data suggest that the market has been sensitive to the demand for this kind of software. Overall, the distribution of software among the various school subjects does not appear to have changed much over the years.

Trends Within Major School Subjects: Distribution by Area

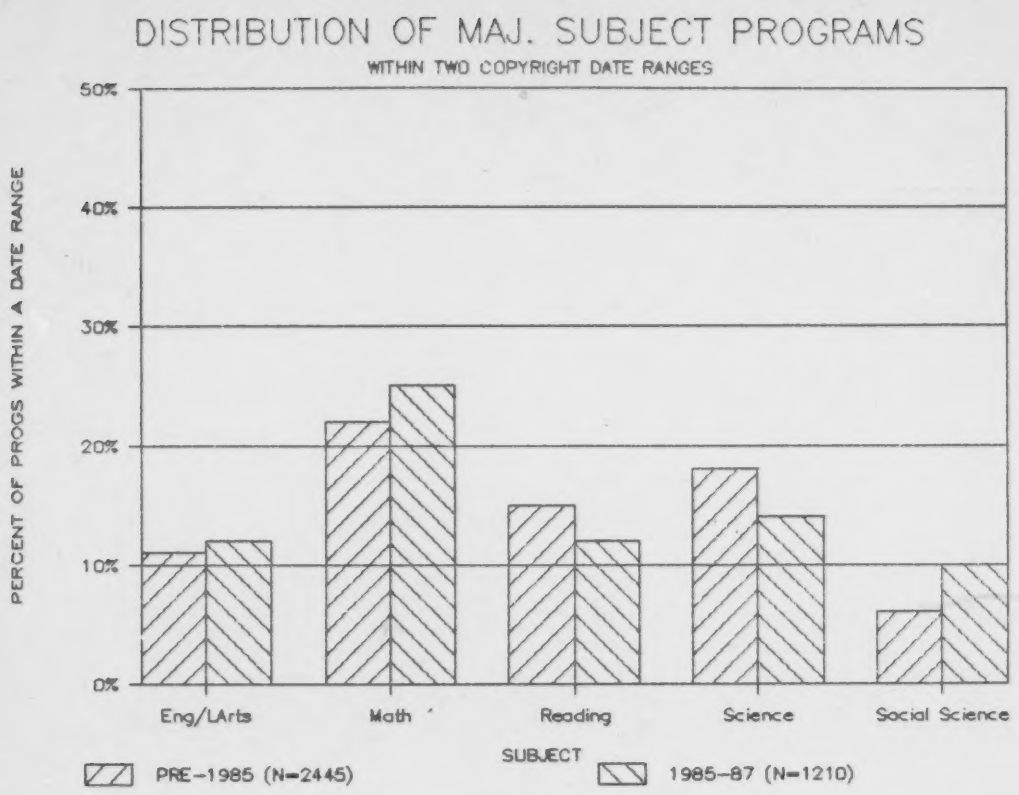
Within each date range, we calculated, for the major school subjects, the percentage of programs in each area out of the total number of programs in that subject. Overall, the changes in percentages were slight, ranging from 0% to 14% change.

For Reading, most differences are less than 5%. The exception is Reading in Content Areas, which represents a slightly lower percentage of all Reading software in 1985-1987 compared to pre-1985.

In English/Language Arts, Basic Skills represents a slightly higher percentage of the total in 1985-1987 compared to pre-1985, while Literature represents a slightly lower percentage of the total in 1985-1987 compared to pre-1985. The percentage of ESL software remained approximately the same.

In Mathematics, Algebra represents a slightly higher percentage of the total in 1985-1987 compared to pre-1985, whereas Basic Skills represents a slightly lower percentage of the total in 1985-1987 compared to pre-1985. The percentages in the other Mathematics areas remained approximately the same.

FIGURE 3



Source: Educational Products Information Exchange (EPIE) Institute, The Educational Software Selector (TESS) Online, (Water Mill, New York: Unpublished, in-house version updated through July 1987).

From pre-1985 to 1985-1987, the areas showing more than a 5% increase in the percent of all Science software they represent include Anatomy/Physiology, Astronomy, and Biology. From pre-1985 to 1985-1987, the areas showing more than a 5% decrease in the percent of all Science software they represent include Chemistry and Physics. The percentages in all other Science areas remained approximately the same.

In Social Science, only Psychology shows a difference of more than 5% in the percent of all Social Science software it represents from pre-1985 to 1985-1987.

Distribution of Programs by Type

The software programs are categorized by type. The following types are included:

Rote Drill - The computer is used to administer drills to help students learn material requiring few, if any, new skills (e.g., dates, arithmetic tables). The computer provides immediate feedback regarding the correctness of student responses; it may also report overall performance.

Skills Practice - The computer is used to provide exercises enabling the student to practice new skills (e.g., factoring, conversion between metric units, musical pitch discrimination). The computer provides immediate feedback regarding student responses; it may also record and report performance.

Tutorial - The computer is used to implement most of the instructional process (traditionally known as CAI). A comprehensive tutorial system may contain provisions for all of the following: student placement, introduction of new material, drill, practice, performance monitoring, remediation, and reporting of progress.

Concept Demonstration - The computer is used to illustrate, usually dynamically, the operation of a principle (e.g., daily compounding of interest, a function approaching a limit).

Concept Development - The computer is used to provide an experience designed to promote the learning of higher-order concepts and/or skills.

Hypothesis Testing - The computer is used to provide a large body of data about a given situation (e.g., census or election results) establishing a laboratory for testing alternative hypotheses to explain a phenomenon in the situation (e.g., why one section of the country supports a particular issue).

Educational Game - The computer plays or provides computational support for a game in which one or more students participate. The learning of new concepts or skills is promoted.

Simulation - The computer is used to model a real-life or imaginary situation in a dynamic fashion so that students can interact with it and thereby learn about it. Simulations usually embody situations which students could not experience otherwise because of financial, safety, time, or other constraints (e.g., experimenting with the factors impinging on a body of water undergoing pollution).

Tool Programs - This includes word processors, computational tools (e.g., spreadsheet, statistical package), and language processors (e.g., compilers, interpreters, assemblers).

Percentages of software by type are presented in Table 8. As before, the total of these percentages is greater than 100% because some programs are assigned to more than one type.

The largest percentages of software are categorized as Skills Practice (51%), Tutorial (33%), Educational Game (19%), Rote Drill (15%) and Tool (11%). (Keep in mind that most programs categorized as Educational Game are categorized as Skills Practice, Tutorial, or Rote Drill as well.) The smallest percentage of programs is categorized as Hypothesis Testing. This distribution suggests that the majority of software programs have been designed to develop or practice what are usually thought of as lower order thinking skills. Only a small percentage of programs appear to address higher order skills (e.g., Hypothesis Testing, Concept Development, and Simulation programs).

In order to examine the distribution of software within subjects by type, the percentage of each program type within each subject category was calculated.

Distribution of Major Subject Programs by Type

Table 9 presents the distribution of major subject programs by type. Within Reading, the highest percentages of software fall within the Skills Practice (74%), Educational Game (29%), Rote Drill (25%) and Tutorial (24%) categories. For English/Language Arts, the distribution is similar, with the highest percentages of software falling within the Skills Practice (72%), Tutorial (36%), Rote Drill (26%), and Educational Game (24%) categories.

Within Mathematics, the highest percentages of software are included in the Skills Practice (55%), Tutorial (28%), and Educational Game (13%) categories. This is similar to the overall distribution of software by type.

For Science, the highest percentages of software are in the Tutorial (45%), Skills Practice (37%), Simulation (32%) and Educational Game (12%) categories. When compared to the overall distribution of software by type, Science contains a higher percentage of Simulations, as expected.

The last major subject category is Social Science. Here the highest percentages of software fall within the Tutorial (37%), Skills Practice (32%), Educational Game (32%), Simulation (21%) and Rote Drill (18%) categories. Although this subject category as a whole contains fewer programs (8%), these programs appear to be more evenly distributed among the type categories.

Overall, all major subjects contain a high proportion of programs of the Skills Practice and Tutorial types. In addition, Science and Social Science have higher percentages of simulations.

TABLE 8. DISTRIBUTION OF PROGRAMS BY TYPE (N=7325)

	Percent of Programs*	No. of Programs*
Rote Drill	15%	1107
Skills Practice	51%	3708
Tutorial	33%	2447
Concept Demonstration	3%	216
Concept Development	4%	270
Hypothesis Testing	1%	91
Educational Game	19%	1425
Simulation	9%	669
Tool Programs	11%	807

* The sum of the programs in each program type category is greater than N due to the fact that some programs were assigned to more than one program type category. Accordingly, the total of the percentages is greater than 100%. All percentages were rounded to the nearest unit.

Source: Educational Products Information Exchange (EPIE) Institute, The Educational Software Selector (TESS) Online, (Water Mill, New York: Unpublished, in-house version updated through July 1987).

TABLE 9. DISTRIBUTION OF MAJOR SUBJECT PROGRAMS BY TYPE

SUBJECT	PROGRAM TYPE									SUBJECT TOTAL
	Rote Drill	Skills Pract	Tutor	Concpt Demo	Concpt Devl	Hyp Test	Educ Game	Simu	Tool	
English/Language Arts*	26%	72%	36%	0%	1%	0%	24%	0%	6%	
	229	640	318	1	13	1	216	2	58	894
Mathematics*	9%	55%	28%	2%	3%	0%	13%	3%	5%	
	186	1089	550	49	61	0	264	52	94	1971
Reading*	25%	74%	24%	0%	1%	0%	29%	0%	2%	
	215	645	207	0	12	0	253	4	16	869
Science*	9%	37%	45%	8%	6%	1%	12%	32%	8%	
	107	424	514	88	70	12	140	365	89	1148
Social Science*	18%	32%	37%	4%	7%	2%	32%	21%	4%	
	100	182	209	25	37	13	183	119	24	565

* In each subject category row, a percent represents the percent of all programs of a given type within that subject category. All percentages were rounded to the nearest unit. The number below each percent represents the actual number of programs for that subject and program type. For each subject, the sum of the numbers in the program type columns is greater than the number in the subject total column, because some programs were assigned to more than one program type.

Source: Educational Products Information Exchange (EPIE) Institute, The Educational Software Selector (TESS) Online, (Water Mill, New York: Unpublished, in-house version updated through July 1987).

Distribution of Non-major Subject Programs by Type

Within the non-major subjects, the highest percentag ges of software for most subject categories fall within Skills Practice, Tutorial, Rote Drill and Educat ional Game. In addition, the Comprehensive, Computers, Fine Arts, Guidance, Health, Home E Economics, Industrial Arts and Physical Education subject categories include a high percentage (grea ater than 20%) of Tool programs. These are subjects for which Tools appear to be highly appropriate.

Distribution of Major Subject Programs by Area and Type

In Reading, the highest percentage of software in all areas falls within the Skills Practice category. In the Reading in Content Areas category, there is a higher percentage of Tutorials and a much lower percentage of Educational Games than in the othe er areas.

In English/Language Arts, all areas contain a high percentage of Skills Practice programs. For Basic Skills programs, the largest percentages of soft ware fall within the Skills Practice (73%), Tutorial (35%), Rote Drill (24%), and Educational Game (24 %) categories. Within the Literature category, besides the high percentage of Skills Practice pr rograms, many are categorized as Rote Drill (63%). Within ESL, in addition to a high percentage of Ski ills Practice programs, many programs fall within the Tutorial (56%) and Educational Game (42%) categ ories. Note, however, that most of the programs categorized as Educational Game are, in fact, also categorized as either Skills Practice or Tutorial. Apparently producers of ESL programs feel that gaming is especially motivating to ESL students.

In Mathematics, the highest percentages of program ns for all areas fall within the Skills Practice and Tutorial categories. In addition, for some of the more advanced mathematics areas -- Analysis, Calculus, Probability, Statistics, Trigonometry -- large percentages of software are categorized as Concept Demonstration, Concept Development, Simulation, or Tool.

In the Science areas, high percentages of programs fall within a wider variety of software types than in the other major subject categories. This may be due in part to the way science is traditionally taught. Laboratory experiences are a regular part of the Science curriculum and lend themselves to the use of Simulations and Tools. In additi on to high percentages of software in the Skills Practice, Tutorial, and Educational Game categories, most science areas include a high percentage of software in the Simulation category, the exc eptions being Basic Skills and Oceanography. A high percentage of Tool Programs are found in Basic Skil ls, Anatomy and Physiology, Astronomy, and Technology Education.

In the Social Science areas, high percentages of programs fall within the Skills Practice, Tutorial, and Educational Games categories. Several areas contained a large percentage of Simulations (i.e., greater than 30%), including Civics/Government, Eco nomics, Law, Political Science, Psychology, and Sociology.

Distribution of Programs by Type Within Grade Ran ges

In order to examine the distribution of software by type within each grade range, percentages of programs by software type were calculated for each grad e range. These percentages are presented in Table 10. For all grade ranges, the highest proportion of programs is of the Skills Practice type.

TABLE 10. DISTRIBUTION OF PROGRAMS BY TYPE WITHIN GRADE RANGES

GRADE RANGE	PROGRAM TYPE									GRADE RANGE TOTAL
	Rote Drill	Skills Pract	Tutor	Concpt Demo	Concpt Devl	Hyp Test	Educ Game	Simu	Tool	
Kindergarten*	29%	65%	14%	1%	4%	0%	31%	1%	15%	
	169	383	84	3	24	0	182	6	88	589
Grades 1-3*	23%	65%	23%	0%	4%	0%	31%	3%	9%	
	417	1178	423	9	69	4	563	49	165	1805
Grades 4-6*	15%	63%	34%	1%	4%	1%	29%	5%	9%	
	500	2022	1104	35	131	17	930	177	303	3234
Grades 7-8*	14%	55%	38%	2%	4%	1%	25%	8%	13%	
	518	1970	1355	69	142	49	916	301	453	3603
Grades 9-12*	13%	47%	38%	4%	4%	2%	18%	13%	16%	
	603	2126	1736	199	184	89	802	599	737	4514

* In each grade range category row, a percent represents the percent of all programs of a given type within that grade range category. All percentages were rounded to the nearest unit. The number below each percent represents the actual number of programs for that grade range and program type. For each grade range, the sum of the numbers in the program type columns is greater than the number in the grade range total column because some programs were assigned to more than one program type.

Source: Educational Products Information Exchange (EPIE) Institute, The Educational Software Selector (TESS) Online, (Water Mill, New York: Unpublished, in-house version updated through July 1987).

At the Kindergarten level, the greatest percentages of software fall within the Skills Practice (65%), Educational Games (31%), Rote Drill (29%), Tool (15%) and Tutorial (14%) categories. For grades 1-3, the percentages of Skills Practice and Educational Games remain the same. The percentage of software in the Tutorial category increases while the percentages of Rote Drill and Tool programs decrease.

For grades 4-6, the availability of programs by type is similar to that for grades 1-3, with a slight decrease in Rote Drill, and a slight increase in Tutorial.

Examining the data for grades 7-8 and 9-12, in addition to programs of the Skills Practice type, many are categorized as Tutorial, Educational Game, Tool, or Rote Drill.

Distribution of Programs by Use

The software programs are identified (based on information collected from the producers) as to their appropriate use: Main-line Curriculum, Remediation or Special Education. Percentages of software by use are presented in Table 11.

The largest percentage of programs (89%) is designed for Main-line Curriculum use, as expected, with 53% of the programs designed for Remediation and 26% designed for Special Education.

Distribution of Programs by Use Within Subjects

In order to examine the distribution of software within subjects by use, percentages of programs falling within each use category are calculated for each subject category.

Table 12 presents the distribution of major subject programs by use. Within the major subject areas, the percentage of use in Main-line Curriculum ranges from 71% (Mathematics) to 98% (English/Language Arts and Reading). The percentages of programs designed for Remediation ranges from 37% (Science) to 67% (English/Language Arts). The percentages of programs designed for Special Education ranges from 6% (Reading) to 45% (Science).

For all of the non-major subjects except Agriculture, the vast majority of software is designed to be used as Main-line Curriculum. A smaller proportion of software can be used in either Remediation or Special Education.

Distribution of Major Subject Programs by Area and Use

In Reading, almost all software in each area is designed to be used in Main-line Curriculum. Only Decoding Skills (10%), Vocabulary (9%), and Comprehension (5%) include programs designed for Special Education.

In English/Language Arts, 98% of the software in each of the areas is designed for Main-line Curriculum. More than 65% of the software in the Basic Skills and Literature areas is designed for Remediation, while only 42% of the software for ESL is recommended for remedial use. Only a small percentage of software in the Basic Skills area is designed for use in Special Education (7%), whereas a large percentage of Literature programs is designed for such use (63%).

TABLE 11. DISTRIBUTION OF PROGRAMS BY USE (N=7325)

	Percent of Programs*	No. of Programs*
Main-line Curriculum (MC)	89%	6539
Remediation (RE)	53%	3907
Special Education (SE)	26%	1894

* The sum of the programs in each use category is greater than N due to the fact that some programs were assigned to more than one use category. Accordingly, the total of the percentages is greater than 100%. All percentages were rounded to the nearest unit.

Source: Educational Products Information Exchange (EPIE) Institute, The Educational Software Selector (TESS) Online, (Water Mill, New York: Unpublished, in-house version updated through July 1987).

TABLE 12. DISTRIBUTION OF MAJOR SUBJECT PROGRAMS BY USE

SUBJECT	USE: Main-Line Curriculum	USE: Remediation	USE: Special Education	SUBJECT TOTAL
English/Language Arts*	98% 876	67% 597	11% 94	894
Mathematics*	71% 1398	47% 918	9% 187	1971
Reading*	98% 854	57% 495	6% 48	867
Science*	93% 1073	37% 422	45% 522	1148
Social Science*	96% 542	54% 306	22% 127	565

* In each subject category row, a percent represents the percent of all programs of a given use within that subject category. All percentages were rounded to the nearest unit. The number below each percent represents the actual number of programs for that subject and use. For each subject, the sum of the numbers in the use columns is greater than the number in the subject total column, because some programs were assigned to more than one use.

Source: Educational Products Information Exchange (EPIE) Institute, The Educational Software Selector (TESS) Online, (Water Mill, New York: Unpublished, in-house version updated through July 1987).

For Mathematics programs, in all areas other than Basic Skills, more than 90% of the software is designed for use in Main-line Curriculum. In the Basic Skills area, 62% of the software falls into the Main-line Curriculum category, 45% into the Remediation category and only 1% into the Special Education category. For the other areas containing at least 5% of the Mathematics programs, percentages in the Remediation category are 44% for Algebra and 60% for Geometry. In the Special Education category, 1% are for Basic Skills, 13% are for Geometry, and 19% are for Algebra.

In all areas of Science, more than 86% of the programs are designed for Main-line Curriculum use. For areas containing at least 5% of the Science programs (Biology, Chemistry, Earth Science, General Science, Physics), percentages in the Remediation category range from 15% to 62%. For the same areas, percentages in the Special Education category range from 1% to 65%.

As in the other major subject areas, for Social Science, the vast majority of programs in each area (at least 81%) are designed for Main-line Curriculum use. For areas containing at least 5% of the Social Science programs (Basic Skills, Civics/Government, Economics, Geography, History, Psychology), percentages in the Remediation category range from 22% to 70%. For the same areas, percentages in the Special Education category range from 8% to 63%.

Distribution of Programs by Use Within Grade Ranges

In order to examine the distribution of software by use within each grade range, percentages of programs by software use were calculated for each grade range. These percentages are presented in Table 13.

For all grade ranges, the highest percentage of use was for Main-line Curriculum, ranging from 96% to 99%. For Remediation, percentages ranged from 53% for grades 9-12 to 73% for Kindergarten. The most variation was in the percentages for Special Education use. The percentages are relatively low for Kindergarten (6%), grades 1-3 (6%), and grades 4-6 (11%), and somewhat higher for grades 7-8 (23%) and grades 9-12 (42%).[2]

Distribution of Programs by Computer Family

Percentages of software by computer family (e.g., Apple II, Commodore 64 and 128, IBM-PC and Compatibles) are presented in Table 14.

The largest percentages of software are available for the Apple II family (73%), Commodore 64 and 128 (24%), IBM PC and Compatibles (22%), and Radio Shack Models I, III and IV (19%). Less than 10% of the software programs are available for each of the other computer families.

---

2. Keep in mind that the categorization of programs as suitable for Special Education was made by the software publishers. Analysts of the Special Education market warn that identifying a program for grades K-6 as appropriate for Special Education may have a negative impact on Main-line Curriculum sales, whereas identifying a program for grades 7-12 as suitable for Special Education may have no impact on Main-line Curriculum sales. This may be due to the fact that the teaching of basic skills dominates the early grades, and such teaching is substantially different for Special Education and Main-line Curriculum students. The later grades focus more on learning content; if a student can read what is on the screen, the software may be usable to some extent.

TABLE 13. DISTRIBUTION OF PROGRAMS BY USE WITHIN GRADE RANGES

GRADE RANGE	USE			GRADE RANGE TOTAL
	Main-Line Curriculum	Remediation	Special Education	
Kindergarten*	99% 581	73% 431	6% 38	589
Grades 1-3*	99% 1787	69% 1242	6% 112	1805
Grades 4-6*	99% 3187	66% 2119	11% 342	3234
Grades 7-8*	98% 3516	62% 2218	23% 826	3603
Grades 9-12*	96% 4322	53% 2395	42% 1889	4514

* In each grade range category row, a percent represents the percent of all programs of a given use within that grade range category. All percentages were rounded to the nearest unit. The number below each percent represents the actual number of programs for that grade range and use. For each grade range, the sum of the numbers in the use columns is greater than the number in the the grade range total column, because some programs were assigned to more than one use.

Source: Educational Products Information Exchange (EPIE) Institute, The Educational Software Selector (TESS) Online, (Water Mill, New York: Unpublished, in-house version updated through July 1987).

TABLE 14. DISTRIBUTION OF PROGRAMS BY COMPUTER FAMILY
(N=7325)

	Percent of Programs*	No. of Programs*
Apple II	73%	5350
Apple Macintosh	1%	59
Atari 400-1200	6%	425
Commodore PET and VIC	9%	689
Commodore 64 and 128	24%	1735
Radio Shack I, III, and IV	19%	1365
Radio Shack Color Computer	4%	263
IBM PC and Compatibles	22%	1593
Other**	10%	719

* The sum of the programs in each computer family category is greater than N due to the fact that some programs were assigned to more than one category. Accordingly, the total of the percentages is greater than 100%. All percentages were rounded to the nearest unit.

** The *Other* category combines all remaining computer families, each accounting for less than 1% of the total number of programs.

Source: Educational Products Information Exchange (EPIE) Institute, The Educational Software Selector (TESS) Online, (Water Mill, New York: Unpublished, in-house version updated through July 1987).

Distribution of Programs by Computer Family Within Grade Ranges

In order to examine the distribution of software by computer family within each grade range, percentages of programs for each computer family are calculated for each grade range. These percentages are presented in Table 15.

For all grade ranges, the highest percentage of software availability is for the Apple II family, which increases from Kindergarten through grades 9-12, ranging from 74% to 81%. Likewise, the percentage of software availability for the IBM PC and Compatibles increases from Kindergarten through grades 9-12, ranging from 15% to 27%. The percentage of software availability for the Commodore 64 and 128 remains steady from Kindergarten through grades 4-6 (approximately 30%) and then decreases through grades 9-12 (21%).

Interpreting the Data on Computer Family

Software publishers are constantly seeking ways to maximize their consumer base. The data on computer family suggest that to do this, publishers must produce an Apple II family version, as well as one or more other versions of each program. The decision as to which other version to produce will vary depending on the grade range of the target audience.

Distribution of Programs by Cost

In order to examine the distribution of software by cost ranges, the percentages of programs for $1-$50, $51-$100, $101-$150, $151-$200, $201-$250, $251-$300, $301-$450, $451-$600, $601-$750, and over $750 were calculated.[3] These percentages are presented in Table 16. The largest percentage of software falls within the $1-50 range. (We are aware of a great many programs priced at $39.95.) Twenty-nine percent of the software falls within the $51-$100 category. (We know of many programs priced at $59.95.) Less than 5% of the software falls into any of the cost ranges above $100.

The majority of the educational software programs appear to be priced at $50 or less, with over 85% priced at $100 or less. Very few programs cost more than $200. This pattern is consistent across the grade ranges. However, the percentage within the $1-$50 range decreases across the grade ranges from Kindergarten through grades 9-12 (from 70% to 54%), and the percentage within the $51-$100 range increases across the grade ranges from Kindergarten through grades 9-12 (from 18% to 31%).

SCHOOL NEED RELATIVE TO SOFTWARE

To make any meaningful assessment of the scope of the educational software market, current school needs must be considered. In an attempt to identify school needs that might be satisfied by educational software, we collected data about time spent on various subjects (available only for grades 7-12) and curriculum requirements in a sample of states. Other data sources include five national-level reports and three firms that consult to the educational software industry.

---

3. Both *The Educational Software Selector* (TESS) and *The Microcomputer Software and Hardware Guide* (MSHG) include information about the cost of the software programs listed in the databases. However, since the information from the TESS database is believed to be more reliable, only the TESS information was used for this analysis. (For details about the comparison of the distributions of programs by cost in TESS and MSHG, see Appendix II.)

TABLE 15. DISTRIBUTION OF PROGRAMS
BY COMPUTER FAMILY WITHIN GRADE RANGES

	COMPUTER FAMILY									
GRADE RANGE	Apple II	Apple Mac	Atari 400-1200	Comm PET/VIC	Comm 64/128	Rad Sh I/III/IV	Rad Sh Color	IBM*	Other**	GRADE RANGE TOTAL
Kindergarten***	74%	1%	12%	7%	32%	13%	12%	15%	14%	
	436	8	70	43	191	76	71	91	83	589
Grades 1-3***	76%	1%	11%	10%	29%	14%	7%	16%	11%	
	1374	11	193	176	527	256	125	295	202	1805
Grades 4-6***	77%	1%	9%	10%	30%	19%	4%	19%	9%	
	2503	19	276	326	955	600	133	625	301	3234
Grades 7-8***	81%	1%	6%	8%	25%	20%	3%	22%	9%	
	2921	26	229	297	906	723	107	796	314	3603
Grades 9-12***	80%	1%	5%	9%	21%	21%	3%	27%	10%	
	3632	51	204	387	955	961	115	1199	447	4514

* IBM PC and compatibles.

** The *Other* category combines all remaining computer families, each accounting for less than 1% of the total number of programs.

*** In each grade range category row, a percent represents the percent of all programs with a given computer family version within that grade range category. All percentages were rounded to the nearest unit. The number below each percent represents the actual number of programs for that grade range and computer family. For each grade range, the sum of the numbers in the computer family columns is greater than the number in the grade range total column because some programs are available in more than one computer family version.

Source: Educational Products Information Exchange (EPIE) Institute, The Educational Software Selector (TESS) Online, (Water Mill, New York: Unpublished, in-house version updated through July 1987).

TABLE 16. DISTRIBUTION OF PROGRAMS BY COST*

	Percent of Programs	No. of Programs
$1-50	57%	3742
$51-100	29%	1893
$101-150	4%	288
$151-200	4%	254
$201-250	1%	89
$251-300	1%	98
$301-450	1%	91
$451-600	1%	45
$601-750	<1%	9
Over $750	1%	38

* Cost data was available for 6,547 of the 7,325 K-12 educational software programs identified for this study. Each program was assigned to only one cost range. If different computer family versions are sold at different prices, the cost of the Apple II family version was used.

Source: Educational Products Information Exchange (EPIE) Institute, The Educational Software Selector (TESS) Online, (Water Mill, New York: Unpublished, in-house version updated through July 1987).

TABLE 17. DISTRIBUTION OF TIME SPENT IN GRADES 7-12 BY SUBJECT

SUBJECT	GRADE RANGE 7-8	9-12
COMMUNICATION SKILLS*	18%	18%
SOCIAL SCIENCE	16%	14%
MATHEMATICS	16%	13%
SCIENCE	14%	12%
Fine Arts	8%	5%
Physical Education	5%	3%
Health	4%	1%
Industrial Arts/Career Ed.	4%	1%
Foreign Language**	-	3%
Other	15%	30%

* Communication Skills includes English/Language Arts and Reading.

** No percentage data was reported specifically for Foreign Language in grades 7-8. Time spent in this subject is included under the Other category.

Source: Data provided by State Departments of Education in Minnesota, New York, Ohio, Pennsylvania, Mississippi, Connecticut, and California.

TABLE 18. COMPARISON OF TIME SPENT BY SUBJECT IN GRADES 7-8 WITH SOFTWARE AVAILABLE

SUBJECT*	TIME SPENT**	SOFTWARE AVAILABLE***
Communication Skills****	High	High
Social Science	High	Moderate
Mathematics	High	High
Science	High	Moderate
Fine Arts	Moderate	Low

* Subjects included are those for which more than 5% of time is spent in school.

** The percentage of time spent for any given subject ranges from less than 1% to 18%. Subjects accounting for 13%-18% of the time spent are rated *High*. Subjects accounting for 7%-12% of the time spent are rated *Moderate*.

*** The percentage of software available for any given subject ranged from less than 1% to 24%. Subjects accounting for 17%-24% of the software are rated *High*. Subjects accounting for 9%-16% of the software are rated *Moderate*. Subjects accounting for less than 9% of the software were rate *Low*.

**** Communication Skills includes both English\Language Arts and Reading.

Sources: Data concerning Time Spent: State Departments Of Education in Minnesota, New York, Ohio, Pennsylvania, Mississippi, Connecticut, and California. Data concerning Software Available: Educational Products Information Exchange (EPIE) Institute, The Educational Software Selector (TESS) Online, (Water Mill, New York: Unpublished, in-house version updated through July 1987).

TABLE 19. COMPARISON OF TIME SPENT BY SUBJECT IN GRADES 9-12 WITH SOFTWARE AVAILABLE

SUBJECT*	TIME SPENT**	SOFTWARE AVAILABLE***
Communication Skills****	High	High
Social Science	High	Moderate
Mathematics	High	High
Science	Moderate	Moderate

* Subjects included are those for which more than 5% of time is spent in school.

** The percentage of time spent for any given subject ranges from less than 1% to 18%. Subjects accounting for 13%-18% of the time spent are rated *High*. Subjects accounting for 7%-12% of the time spent are rated *Moderate*.

*** The percentage of software available for any given subject ranged from less than 1% to 23%. Subjects accounting for 16%-23% of the software are are rated *High*. Subjects accounting for 8%-15% of the software are rated *Moderate*.

**** Communication Skills includes both English\Language Arts and Reading.

Sources: Data concerning Time Spent: State Departments Of Education in Minnesota, New York, Ohio, Pennsylvania, Mississippi, Connecticut, and California. Data concerning Software Available: Educational Products Information Exchange (EPIE) Institute, The Educational Software Selector (TESS) Online, (Water Mill, New York: Unpublished, in-house version updated through July 1987).

School Need as Defined by State Curriculum Data

Information from eight states (New York, Ohio, Minnesota, Pennsylvania, Virginia, Mississippi, Connecticut, and California) concerning curriculum requirements and (where available) time spent on various subjects was gathered and analyzed. (See Appendix III for more information concerning the sampling strategy.) The states selected are representative of various geographic regions and such various socio-economic considerations as racial/ethnic mix in the population, industrial bias, and mix of household income levels. The information from New York, Ohio, Minnesota, Pennsylvania, Mississippi, Connecticut, and California was particularly useful in determining the relative level of importance placed on the major curriculum categories. The information from these states provided specific indications of either credit hours to be taken or amount of instructional hours to be devoted to each category (for grades 7-12 only). Virginia did not provide such information.

The data collected from the states pertaining to the percentage of time spent on various subjects are summarized in Table 17 and suggest how State Departments of Education view the relative importance of the various school subjects in the curriculum. As expected, in both grade ranges the largest percentages of time are spent on the major subjects: Communication Skills (Language Arts and Reading), Mathematics, Social Science, and Science. The data suggest one important difference between grades 7-8 and grades 9-12: the percentage of time spent on subjects other than Communication Skills, Social Sciences, Mathematics, Science, Fine Arts, Physical Education, Health, Industrial Arts/Career Education, and Foreign Languages (15% in grades 7-8 compared to 30% in grades 9-12). This reflects the wider choice of curriculum options available to students in senior high school.

Comparing the time spent on various subjects (one measure of their relative importance in the curriculum) to the supply of available software provides some indication of how well school needs are being met. To make the comparison, percentages of time spent in the different subjects were converted to a three-point scale (high, moderate, low). Similarly, the percentages of software available for different subjects within each grade range (7-8 and 9-12) were converted to three-point scales. Tables 18 and 19 show the comparisons (for grades 7-8 and 9-12, respectively) for subjects in which the percentage of time spent is greater than 5%. The data suggest that for grades 7-8, Science, Social Studies, and Fine Arts software may be slightly underproduced relative to school need. The data for high school suggest that Social Studies software may be slightly underproduced relative to school need.

These comparisons offer only one indicator of the match between school need and the existing software supply. Other factors that should be considered include the amount of computer time allotted to various subjects, and the availability of open-ended tools that are applicable across the curriculum.

School Need as Defined by
National Reports and Surveys

For the last four and a half years, the U.S. school system has been the subject of intense scrutiny by more than half a dozen groups or commissions including the National Commission on Excellence in Education, the Carnegie Corporation's Forum on Education and the Economy, the Holmes Group, the National Governors' Association, and the National Task Force on Educational Technology. Reports from many of these groups have implications regarding the needs of the nation's schools for educational software.

The five reports reviewed were as follows:

A Nation at Risk: The Imperative for Educational Reform, National Commission on Excellence in Education.

A Nation Prepared: Teachers for the 21st Century, Carnegie Forum on Education and the Economy.

Tomorrow's Teachers, The Holmes Group.

Time for Results: The Governors' 1991 Report on Education, National Governors' Association, Center for Policy Research and Analysis.

Transforming American Education: Reducing the Risk to the Nation, National Task Force on Educational Technology.

In addition, reports from three firms that consult with educational software publishers were reviewed:

TALMIS: Types of software used in schools.

EDUCATION TURNKEY SYSTEMS: Microcomputer Use in Special Education.

INTERACTIVE EDUCATIONAL SYSTEMS DESIGN: ESL/Bilingual Education Software.

A Nation at Risk

The most recent round of educational reform studies and reports began with A Nation at Risk.[4] In this report, the National Commission on Excellence in Education heralded a cry for the United States to improve its educational system to regain our competitive position in the world economy and to retain our individual and national freedom.

Problem Subjects and Areas Identified. Several of the 13 "Indicators of the Risk" documented in the report address specific deficiencies in the schools' curricula and/or teaching methods, including:

- The high level of functional illiteracy among adults, 17-year-olds, and particularly minorities
- The need for remedial education in reading, writing, spelling, and computation among new recruits in the military and in industry
- A steady decline in science achievement

4. The National Commission on Excellence in Education, A Nation at Risk: The Imperative for Educational Reform (Washington, DC: United States Department of Education, April 1983).

* The lack of "higher order" intellectual skills demonstrated by large majorities of teenagers, including:

  - drawing inferences from written material

  - writing a persuasive essay

  - solving multi-step mathematics problems

The authors point out that in some states, students have the freedom to choose half or more of the units required for graduation, and that throughout the nation, the proportion of students taking the general course of study has increased (from 12% in 1964 to 42% in 1979), as opposed to vocational and college preparation programs. They cite, as examples of the effects of this freedom of choice, the relatively low percentages of students completing intermediate Algebra, French I, Geography, and Calculus.

If well-designed, highly motivating software were designed for the more demanding high school subjects themselves, these subjects might attract more students.

Furthermore, the statistics presented in A Nation at Risk suggest a lack of preparation in grades 1-8 for the more demanding high school subject areas. They also suggest the need for grabbing student interest in the more challenging disciplines before students get to high school. Disciplines mentioned by the authors include English language development and writing, computational and problem solving skills, Science, Social Studies, Foreign Language, and the Arts. Quality software could play a role in both improving student preparation and increasing their interest.

Simulations, instructional tools (e.g., wordprocessors, databases), and software allowing for the testing of alternate hypotheses or the open-ended exploration of a concept all can expand the curriculum, allowing students to be active participants in the learning process.

Improvement of Study Skills. The report points to the haphazard, unplanned teaching of study skills resulting in poor study habits.

This suggests the need for initial study skills instruction in the early grades. Software can help here (e.g., programs focusing on the development of memory skills such as *Memory Castle* by Sunburst Communications and *Remember* by Designware). At the junior and high school level, software can help students hone their research skills (e.g., Grolier's *The Electronic Encyclopedia* and Sunburst's *How Can I Find It?*).

Software as a Supplement to Textbooks. The authors of A Nation at Risk also note the watering-down of textbooks, a trend which suggests the need for other materials, including software, to provide depth and challenge in the various subjects and areas. It further suggests the need for instruction in Reading in Content Areas; if student skills improve over time, this may improve the market for less "watered-down" texts.

A Nation Prepared

This report[5] takes up many of the themes of A Nation at Risk and extends the inquiry while attempting to point the focus in another direction: the relationship between our educational system and the economy. The findings and recommendations most relevant to the present study are presented below.

The Changing Economy and New Educational Priorities. The report describes our changing economy as moving from highly routinized mass production to one requiring workers who are mathematical problem solvers and life-long learners and adaptors. The report attempts to link these changes to changing educational priorities.

The changes in the workplace suggests the need for general Logic/Problem Solving software, for specifically Mathematics problem solving software, and for software that will encourage students to work and learn cooperatively, in small groups and larger groups (e.g., some simulations and tools). It also suggests the importance of developing study and research skills, including the ability to access information from databases to solve problems. It further suggests the need for software that introduces students to the variety of work opportunities that are available today -- especially work opportunities that combine flexible, creative thinking with technological innovation.

Focus on the Upper Elementary Grades. In the view of the authors, instruction in the upper elementary grades fails to hold student interest or challenge students.

Open-ended tool and simulation software can free teachers to be more demanding of students, while engaging them in highly interactive learning experiences. Keep in mind, however, that the more open-ended a software program is, the more training most teachers are likely to need.

Teacher and Student Together. The report emphasizes the fact that the microcomputer should be seen as a teaching/learning tool, something the teacher and student employ together.

The Conventional Classroom Vs. New Learning Environments. The report promotes the use of the newer learning technologies in non-traditional learning environments, in which students work individually or in small groups.

Tom Snyder, chairman of Tom Snyder Productions, argues that, at least for the near future, only one or two computers will find their way into the typical classroom. He feels that this and the current memory capacity of microcomputers place severe limitations on the computer's ability to truly individualize instruction. Instead, his company is focusing its attention on tools and simulations intended for a classroom with only one computer, programs that help the teacher in the traditional classroom make instruction more engaging and challenging.

Tomorrow's Teachers

The Holmes Group, a consortium of education deans and chief academic officers from the major research universities in each of the fifty states, issued this report[6] as something of a companion report to A Nation Prepared, in April 1986. The report focuses on teacher preparation, licensing, and the role of teacher education institutions. Its importance to this study lies in the report's focus on the need to bring the teachers themselves along in the development of educational reform.

---

5. Carnegie Corporation of New York, Carnegie Forum on Education and the Economy, The Task Force on Teaching as a Profession, A Nation Prepared: Teachers for the 21st Century (New York, NY: May 1986).
6. The Holmes Group, Inc., Tomorrow's Teachers (East Lansing, Michigan: April 1986).

The authors remind us of the need to carefully consider the current level of preparation and experience of the majority of teachers as we attempt to expand, alter, and improve the educational software that we expect these teachers to properly employ in their classrooms.

According to the report, teacher training has not kept pace with the experience of many students with respect to computers and technology, nor with the knowledge explosion in the physical and social sciences. They cite the need for methods courses that feature subject matter-focused studies of teaching and learning, based on academic research and clinical studies of the practices of effective teachers.

Much of what the Holmes Group have to say about the training of teachers can be applied to the development of better software -- particularly, the more pervasive and intelligent use of existing research on learning theory and practices. More important, the Holmes Group details the inherited and imposed deficiencies of our current crop of teachers -- a factor that we feel must be considered in the creation and dissemination of any new, innovative types of educational software.

TALMIS speculated in 1985 that the first wave of educational applications of microcomputers and software primarily involved the substitution of a new technology for an older one -- drill and practice software for workbooks; word processing for the typewriter; a tutorial on, say phonetics, for a lecture or textbook assignment.[7] But as unique and more powerful applications are introduced (e.g., simulations, the use of database managers, spreadsheets, graphing, and three-dimensional imaging), it becomes increasingly difficult for teachers to incorporate these new approaches into their existing classes. These teachers need retraining.

From our personal experience as teacher trainers, we know that teachers with thorough knowledge of their subject matter and an understanding of the learning process can, with retraining, successfully integrate software into their teaching. In many cases, experienced teachers who previously showed signs of burn-out have become re-excited about the teaching/learning process. They have also become more effective teachers. The importance of ongoing, inservice training cannot be emphasized enough.

Time for Results

This report[8] is actually a compilation of a number of task force reports. The report of The Task Force on Technology is of the most interest for the purposes of this study.

New Applications Identified. In the report, some of the most promising new applications of microcomputer software are identified, including the use of simulations to teach higher order thinking skills, artificial intelligence to coach and tutor students, complex databases, drill and practice programs with sophisticated feedback capabilities, and programs designed for handicapped students.

The Need for Teacher Training. The report also stresses the need for intensive teacher training prior to the use of software in the classroom.

The types of software that can be used to help students to develop their problem-solving skills are simulations, tools, and hypothesis testing and concept development software. These also tend to be the types requiring the most intense teacher training, due their open-ended nature.

---

7. Anne Wujcik, TALMIS, New York, NY, personal communication, June, 1987.
8. National Governors' Association, Center for Policy Research and Analysis, Time For Results: The Governors' 1991 Report on Education (Washington, DC: August 1986).

Transforming American Education

The National Task Force on Educational Technology, appointed by Terrell Bell, then Secretary of Education, submitted this report[9] in April 1986, to detail ways that technology might address the issues raised in A Nation at Risk.

The Possible Future for Educational Software. The report envisions the development of new software on the cutting edge of computer technology, incorporating cognitive research, and advances in learning theory, computer science, and artificial intelligence. The authors predict the development of sophisticated, interactive, multimedia, multisensory workstations, capable of providing highly individualized instruction and coaching, with the ability for, at least, limited two-way communication.

The role of teacher would have to be carefully redefined should such expert systems become a regular part of schooling.

Broad Uses for Technology in Education. The Task Force identified several broad uses of technology, including:

* Developing basic knowledge and skills more efficiently than is possible with conventional instruction (via drill and practice software with sophisticated feedback capabilities, and tutorials using expert systems).

* Teaching of higher-order concepts and reasoning skills that are more difficult to develop without the technology (via Logic/Problem Solving programs, simulations, and concept development and hypothesis testing software)

* Developing an understanding of information technology and its uses in society and the work place (i.e., computer literacy programs).

* Developing proficiency in applying computers and related technologies (i.e., learning to use tool software).

The Need for Teacher Training. As is noted in most of the other reports, the authors here stress the need for pre-service and in-service teacher training.

---

9. The National Task Force on Educational Technology, Transforming American Education: Reducing the Risk to the Nation (Washington, DC: United States Department of Education, April 1986).

TALMIS on Types of Software Used in Schools

TALMIS is a company that provides market research data to a variety of industries, including the educational software industry. Unpublished results from a survey they conducted with school district representatives around the country were made available to IESD for the purposes of this report.[10] Below are percentages suggestive of the use of different types of instructional software in schools.

Tools (word processing, database, etc.)	95%
Drill and Practice	90%
Programming Lang.	86%
Learning Games	79%
Graphics software	69%
Problem Solving Pgms.	62%
Tutorial software	57%
Computer managed instruction	43%
Communication software (online)	40%
Computer Assisted Testing	31%

It is likely that tools are the most commonly used software type because they can serve more than one subject, and many areas and topics within a subject. Thus they are viewed by school personnel as highly cost effective. Drill and practice programs are used frequently because they often do not require much teacher preparation or training. Teachers tend to have less difficulty integrating them with the ongoing curriculum than they do other software types. Many of the programs that would qualify as learning games would also be considered drill and practice programs. Programming languages are used frequently as the basis of a subject within itself (i.e., the teaching of Basic, Logo, etc.).

EDUCATION TURNKEY SYSTEMS on
Microcomputer Use in Special Education

EDUCATION TURNKEY SYSTEMS, Inc. is another firm providing market research data to the educational software industry. In a 1987 *Survey of Microcomputer Use in Special Education*[11], they approximate the special education student population at 4.3 million, with 4.1 million being served in public schools. The largest handicapped populations are identified as the learning disabled, speech impaired, and mentally retarded, accounting for over 80% of the total.

---

10. Anne Wujcik, TALMIS, New York, NY, personal communication, June, 1987.
11. Education Turnkey Systems, "Microcomputer Use in Special Education," unpublished summary, 1987.

According to EDUCATION TURNKEY SYSTEMS, total federal, state, and local spending for special education has grown from $4.6 billion in 1976 to approximately $15 billion in 1985. In a summary of survey findings, the authors note that the amount spent on each handicapped student for instructional materials and equipment is about one and one half times that spent on each nonhandicapped student.

The authors found that microcomputers are used most frequently for the learning disabled, mentally retarded, gifted-and-talented, and emotionally disturbed (in that order), and much less frequently with speech impaired students. Primary student activities involving computer use, in order of frequency, are as follows:

- supplementing classroom instruction
- teaching basic skills
- making students computer literate
- teaching students to use the computer as a tool

The vast majority (almost 90%) of special education coordinators surveyed expressed the need for training or assistance in integrating software with the ongoing classroom curriculum. Other often-cited needs include assistance in software selection and a general teacher orientation to software. Approximately 60% of the special education teachers surveyed indicated that they use microcomputers for instructional purposes, and 80% of these have received some training.

These data suggest the need for software specifically designed for special education students, and for separate special education teacher's guides for mainstream software that can be used profitably with special needs students.

INTERACTIVE EDUCATIONAL SYSTEMS DESIGN
on ESL/Bilingual Education Software

In a recent presentation, Interactive Educational Systems Design summarized what is known about the student population and school programs labeled as Limited English Proficiency (LEP), English as a Second Language (ESL), or Bilingual Education.[12]

Since 1975 the United States has experienced the largest wave of immigration since the beginning of the century. Eighty percent of these new immigrants are either Hispanic or Asian. This demographic fact holds important implications for education in the 1990s.[13] First, because the birthrate among recent immigrants is relatively high, an increasing number of first generation Americans will enter the school system. As a result, ESL/bilingual education is likely to take on a new importance.

12. Ellen R. Bialo, "Market Trends in ESL/Bilingual Software." Unpublished paper presented at the Microtrends '87 conference, New York, July 1987.
13. Educational and Societal Futures: Meeting the Technological Demands of the 1990s. Proceeding of a Conference, San Diego State Univ., California National Origin Desegregation Assistance (Lau) Center, 1984.

Currently, there are estimated to be 2.4 million K-12 LEP students.[14] Of these, only 30-40% are receiving ESL/bilingual services.

The total LEP population is expected to increase 30% over the next ten years. The Hispanic immigrant population is expected to increase 35% over the next 10 years. And currently, the highest percentage of school dropouts are Hispanic -- over time there may be political pressure to do something about this. In addition, the Asian immigrant population is expected to increase 23% over the next 10 years.

In reviewing the literature on technology in special education, IESD found that technology can have a significant positive effect on LEP students but that the major impediments to its use are the lack of instructionally and technologically sound software, and the lack of teacher training.

IESD made suggestions for developing ESL/Bilingual Education software -- suggestions that covered four areas:

* Teaching methods
* Technical considerations
* Instruction in English language skills
* Instruction in non-language school subjects

Suggestions Concerning Teaching Methods. IESD suggested developing software that promotes spoken interaction among students and that encourages collaboration -- providing the opportunity to pair less able speakers/writers of English with students who are more proficient. It was also suggested that ESL/Bilingual Education software take into account differences between the student's native culture and the standard American culture. IESD further recommended developing software that assists the teacher in classroom presentations or demonstrations.

Technical Considerations. IESD suggested that ESL/Bilingual Education software take advantage of the microcomputer's graphics, voice, and text presentation capabilities. It was also recommended that software be modifiable by the teacher.

Instruction in English Language Skills. After reviewing the existing supply of software available for LEP students and consulting experts in the field, IESD analysts concluded that the following might aid students in their development of English language skills:

* Vocabulary development software
* Interactive fiction and adventure games -- a potentially powerful instructional source because they promote problem solving using the target language and are highly motivating to students
* Software that exploits artificial intelligence technologies in the development of language and reading skills (e.g., software that can read to children in several languages or can instantly translate the teacher's voice into another language)

---

14. Charles Blaschke, Education Turnkey Systems, Falls Church, VA, personal communication, July 1987.

* Wordprocessing software and supporting materials to promote a "writing workshop atmosphere" in the ESL classroom, including built-in features such as a multilingual dictionary, a spell checker, a homonym checker, and a thesaurus

* Supplemental materials that make the exploration of a programming language appropriate for an ESL/bilingual classroom

Suggestions for Non-language School Subjects. For non-language school subjects, such as Science and Social Science, IESD made the following recommendations.

* Develop software that makes instruction available in English and in the native language.

* Attend to the readability of the text.

* Include tracking and reporting systems, providing the teacher with information about problems related to the student's English language deficiency.

* Adapt existing tool software (e.g., wordprocessors, spreadsheets) for use in ESL/bilingual classrooms (e.g., native language versions, English language versions with native language help systems).

Limitations on the Data Sources Used in Assessing School Need

The data upon which this assessment of school need is based comes primarily from national and state sources. At best, it provides a general overview of curriculum priorities, broad areas of the curriculum in need of improvement, and issues worthy of special attention. This data does not present a complete picture of school need.

Useful data could be collected at the district level for both large and small school districts, and at the local school level. Survey research could ascertain what kinds of software teachers at various grade levels are currently using, and what kinds of software they would like to have. Such research could take into account differences with respect to school subjects and student populations.

Current data are also needed regarding the availability of computer time for different subjects and at different grade levels. Our experience in the schools tells us that some subjects tend to monopolize the available computers (e.g., programming) while in other subjects, the teacher may be fortunate to have access to one computer a few class periods per month.

The national and state view of what goes on in schools and what is needed in schools is often different from the views expressed at the district and local levels. No analysis of school need with respect to software would be complete without this district and local perspective. Further research is strongly suggested prior to any policy decisionmaking or funding efforts by the federal government.

A complete analysis of "school need" should also include the identification of new, emerging ways to improve the learning process -- ways that have not yet filtered down to most school systems and that are, therefore, not yet perceived as "needs." For example, the Holmes Group and the National Task Force on Educational Technology both mention the need to incorporate the latest research on human cognition; reports suggesting specific instructional approaches that make use of cognitive research should be consulted. Technological innovation also holds much promise for improving the learning process; data on developing technologies such CD ROM, CD-I, videodisc, and speech recognition should be gathered and analyzed.

COMPARING SCHOOL NEEDS TO THE CURRENT SUPPLY OF EDUCATIONAL SOFTWARE

Subjects and Areas in Need

Presented below is a list of subjects and areas at specified grade levels that the data presented earlier in this chapter suggest are in need of improvement. Where the data suggest that the subject or area may be underserved, it is noted. Where there is a particular controversy concerning a subject or area, that is noted.

Computer Literacy

There is currently disagreement over what should constitute Computer Literacy. Some feel it should simply mean an overview of the uses of computers in society. Some feel it should include facility with tool software. Some feel it should also include programming experience. We identified 104 Computer Literacy programs, which represents 31% of the 331 programs categorized as Computers. This would seem to be more than adequate coverage. However, the vast majority of these are Tutorials (77 of the 104). An effective Computer Literacy program might also be well served by Simulation programs that give students the opportunity to experience many different computer applications. We could identify only ten Computer Literacy Simulations.

English/Language Arts

In the reports reviewed for this study focusing on "school need," English/Language Arts-Basic Skills were frequently mentioned. Topics over which concern was expressed included Composition/Writing, Spelling, and Language Development (including Grammar and Usage, and Punctuation). Of 794 Basic Skills programs[15], 274 are categorized as Grammar and Usage (35%), 264 as Spelling (33%), 139 as Composition Writing (18%), and 51 as Punctuation (7%). Considering its importance in the curriculum, the Composition/Writing topic may be underserved by the current software market. Further analysis reveals that there are no Grammar and Usage or Punctuation Tool programs. Another English/Language Arts area that seems to be underserved is ESL, especially lacking in Tool and Simulation programs that would encourage student collaboration. This area seems ripe for software that can take advantage of the improved voice and graphics capabilities of the latest microcomputer models.

---

15. The areas included in English/Language Arts-Basic Skills are alphabetizing, composition/writing, grammar and usage, handwriting, punctuation, and spelling.

Fine Arts

There is concern that, in grades 1-8, the Fine Arts have not been made accessible to many students. The extent to which Graphic Art and Music software should supplement more traditional approaches to these disciplines will, no doubt, be debated for quite some time. Throughout grades 1-8, Fine Arts represents 4% of the available software. The data collected suggests that this broad subject may be slightly underserved in grades 7-8. Throughout grades 1-8, in the area of Music, there may be an overabundance of Skills Practice programs (54 of 105 programs). One way software might serve the Fine Arts curricula would be to make basic graphic art and music concepts more accessible to children. We envision open-ended Concept Development programs in which students experiment with, for example, the graphic art concept of perspective or the music concept of pitch.

Foreign Language

Overall, Foreign Language represents 5% of all of the K-12 software, which would seem appropriate for the role Foreign Languages play in the curriculum. Of the 356 Foreign Language programs, 146 are categorized as French (41%), 112 are categorized as Spanish (31%), and 67 are categorized as German (19%), reflecting the popularity of these languages in U.S. schools. Important languages that may be underserved are Russian (22 programs), Japanese (one program), and Chinese (no programs listed). Of course, this may merely be a reflection of how neglected these languages are in U.S. schools. With respect to type classification, the largest percentages of the Foreign Language programs are categorized as Skills Practice (57%), Educational Games (48%), and Tutorial (25%). There is a noticeable lack of programs that would encourage students to use the language in novel situations; only nine programs are categorized as Tools, and only three are Simulations.

Logic/Problem Solving

There is a need for programs that develop general thinking strategies and that link these strategies to the more traditional curriculum.

Mathematics

There is a large supply of Skills Practice and Tutorials focusing on Computational Skills; here the issue may be quality, not quantity. Considering the interest in Mathematics Problem-Solving programs, we identified two topics within Basic Skills that involve problem solving skills: Word Problems and Estimation. Of the 1425 Basic Skills programs[16], only 76 focus on solving Word Problems (5%), and only 20 focus on Estimation (1%). Both topics would seem to be underserved by the current software market. In addition, while the availability of Mathematics programs for grades 7-12 is high, advanced topics other than Algebra (e.g., Geometry; Statistics) may be underserved by the market.

---

16. The areas included in Mathematics-Basic Skills are arithmetic basic skills, coordinate systems and graphing, currency, decimals and percents, equations, estimation, factoring, fractions, inequalities, measurement/metrics, number sentences, number systems and counting, ratio and proportion, telling time and distance, and word problems.

Reading

Student deficiencies in the Reading in Content Areas area have probably contributed to the "writing down" of textbooks. Software focusing specifically on the requirements of comprehending Science and Social Science material could help. Currently only 6% of all Reading programs identified focus on Reading in Content Areas, and the trend is toward developing fewer programs in this area. This area appears underserved. Overall, there is a large supply of programs in the Comprehension Skills areas. There are only 29 programs focusing on Decoding Skills for grades 9-12. New products in this area, taking advantage of the digitized voice capability of the latest computer models, could well serve the adolescent, functionally illiterate.

Science

In general, grades 4-8 seem to be underserved by the current software market. These are the grades in which many student can develop a basic understanding about how the physical world works and a positive attitude toward scientific discovery. Software in the Scientific Methods area is particularly needed, so that students can become familiar with the processes and strategies used by scientists. Of a mere 37 programs focusing on Scientific Methods, only 14 are suitable for grades 4-6, with 23 appropriate for grades 7-8.

Social Science

There appears to be a relative lack of Tool and Hypothesis Testing software for the Elementary Social Studies, History, Basic Skills[17], and Geography areas. The Elementary Social Studies area is also lacking in Simulation software. These software types might help develop higher level thinking skills in Social Science, such as discovering relationships among historical, geographical, and cultural facts. In addition, grades 7-12 may be underserved in general.

Study Skills

Instruction in this topic is needed throughout the grades.

Program Types in Need

Two general areas of need have been expressed with respect to program type: programs that promote higher order thinking skills; and programs that help students to efficiently master basic facts and skills.

Higher Order Thinking Skills

There is much discussion of the need to help students develop "higher order skills" -- to be able to gather data, to organize it, to analyze it, to use it flexibly to synthesize solutions to complex challenges, and to evaluate solutions proposed for such challenges. Critics of the existing system of education in the United States argue that improvement in this area of education will require more than just appropriate microcomputer software. The way classrooms are organized may also have to change: the mostly whole class lecture and recitation instructional approach; the fixed time periods; the focus on a single subject at a time, especially at the high school level.

---

17. The areas included in Social Science-Basic Skills are charts and graphs, decision making and values, locating and organizing information, and map and globe.

Notwithstanding the need for institutional change, software can play a role in the development of higher order skills. Program types that seem appropriate are Tools (e.g., wordprocessors with idea processors that help students organize their thoughts and their writing), Simulations that present complex scenarios not easily brought to the classroom in other ways, Concept Development programs that allow students to explore complex concepts and skills (e.g., graphing algebraic expressions) in an experimental atmosphere, and Hypothesis Testing programs that enable students to test out assumptions about the world by referring to factual databases.

Are sufficient quantities of these program types currently available? The answer is not a simple one. The Concept Development and Hypothesis Testing categories account for only 4% and 1%, respectively, of all the K-12 software identified. However, these categories have two of the most restrictive definitions of all the type categories. Furthermore, the Concept Development category is a recently added type category, and the assigning of older programs to this category may be incomplete. Nonetheless, we believe that there is much room for development of these type of programs. For example, there are now a few geometry programs on the market that allow students to explore and discover the properties of triangles and other geometric forms. Hypothesis Testing programs have great potential in both Science and Social Science, where the goals of these disciplines include theory-building and theory-testing based on observed fact.

Analysis of the data regarding Tool software is a complex task. Only 11% of all of the K-12 programs are categorized as Tools. However, many Tools can be used across the curriculum; thus, one program may serve many more than one set of needs. Furthermore, a quick check of the Tool programs reveals that many not designed specifically for the educational market but actually in use in schools (e.g., Writing Assistant; Dbase II and III) are not listed in the database used for this study. And in certain subjects, the percentage of Tool programs is much higher than 11%: Guidance (53%); Physical Education (50%); Fine Arts (48%); Health (43%); Industrial Arts (30%); and Computers (24%).

The Tool category is quite general by definition. One important question not answered by the data collected is -- Is there a sufficient supply of the kinds of tools that teachers want and need? There is clearly a desire for generic Tools such as wordprocessors, spreadsheets, and database handlers in the schools. According to a recent TALMIS survey, 95% of the districts surveyed use Tools.[18] And there appears to be an abundant supply of these kinds of programs. What are needed are Tools that enhance the capabilities of existing generic Tools. Some already exist, such as a few spelling checkers and outline generators, but more could be done in this area, to broaden the selection of Tool capabilities and to take advantage of the effect competition will have on product quality. We envision programs such as syntax checkers, built-in thesauruses, add-on note-taking organizers, and subject-specific help systems and templates (e.g., a set of prompts for writing up Science lab reports). Because of the great interest that already exists in schools for Tool software, the federal government may want to stimulate new product development of this program type.

The current state of Simulations, another type of software usually thought to promote higher order thinking skills, is also difficult to analyze. While only 9% of all of the programs fall within this category, the percentage is higher for subjects in which Simulations are particularly appropriate. For example in the major school subjects, 32% of the Science software, and 21% of the Social Science software are Simulations (however, there seems to be a need for more Simulations specifically designed for Elementary Social Studies). Of the non-major subjects, 22% of the Business software and 19% of the Home Economics software are Simulations.

---

18. Anne Wujcik, TALMIS, New York, NY, personal communication, June, 1987.

Two subjects for which there are very few Simulations are English/Language Arts (only two programs) and Foreign Language (only three programs). In English/Language Arts, the area of Literature could benefit from Simulations. (We were unable to find any.) We envision, for example, software that enables students to role-play various characters in great literature at the points at which they must make major decisions. We also envision students holding "conversations" with famous characters and authors. The ESL area is also ripe for Simulations in which the student must communicate with a native English "speaker" in various real-world situations. Similar software could be developed for major Foreign Languages, only the native English-speaking student would have to communicate in Spanish, French, German, etc. To be sure, such software would have to be quite sophisticated in design, perhaps requiring a built-in database handler, artificial intelligence capabilities, and digitized voice.

A discussion of Tool, Simulation, Concept Development, and Hypothesis Testing programs would not be complete without mentioning the need for teacher training. One thing these program types have in common is their open-endedness. Both the student and the teacher are confronted with many choices when using such programs. That is the key to their potential for promoting higher-order thinking skills. The open-endedness of these programs also presents great challenges to teachers. What background knowledge should students have prior to using such programs? What additional data should be at the students' disposal. To what extent should the wide array of options provided in such programs be restricted by the teacher, to make the learning experience manageable? How can an open-ended program by used so as to fit within the time constraints of the typical school (e.g., 40 minutes per day)?

These issues strongly suggest the need for teacher training: preservice; and inservice (both off- and on-site). Without such training, only a relative few teachers will have the time and intuition to develop appropriate strategies for using such software. To be sure, the software publishers ought to play a role in such training -- at least by preparing teacher documentation that explains how the software developers conceived that the program should be used.

Efficient Mastery of Basic Skills and Facts

The expression of the need for software programs that promote higher order thinking skills should not be construed as an argument against software that promotes mastery of basic facts and skills. On the contrary, many educators feel that complex problem solving behavior can only be mastered with respect to some known content. Thus the type categories Rote Drill, Skills Practice, and Tutorial have a role to play in the curriculum, and are well-represented in the distribution of program types (15%, 51%, and 33%, respectively). In fact, Skills Practice and Tutorial programs may be over-represented. While there does not seem to be a great call for a general increase in the production of these program types, there is an interest in Skills Practice programs with sophisticated, multi-level feedback systems and Tutorials that serve as an expert system -- a coach to students that monitors student performance and provides explanations, demonstrations, practice, remediation, and more open-ended, exploratory experiences as needed. In other words, there seems to be a need for improvement of program quality rather than quantity.

Program Uses in Need

The data collected thus far suggests the need for improvement of instruction for Remedial students (especially in grades 9-12) and Special Education students throughout grades 1-12. The question of whether the existing supply of software appropriate for these uses is sufficient is difficult to answer due to the fact that the use category data compiled for this study is based on self-reports from the software publishers -- not from independent analysts. In fact, self-reporting from software publishers is the way most publishers of general, all-purpose software directories and databases collect their data. The key problem with this is that software publishers are likely to

provide use data that maximizes their own marketing efforts. Thus, in the lower grades, where experts in the field indicate that labeling a program as suitable for Special Education may hurt Main-line Curriculum sales, software publishers may under-report programs' suitability for Special Education. However, in the upper grades, labeling a program as suitable for Remediation or Special Education is perceived by software publishers as having no negative effect on Main-line Curriculum sales, so there may even be over-reporting, thereby creating new markets for a software program.

Having said this, there are a few school subjects that seem especially low in the reporting of suitability for Special Education. In the major subjects, English/Language Arts, Mathematics, and Reading stand out. In the non-major subjects, Library Skills is worth noting. There seems to be an abundant supply of programs that software publishers indicate are suitable for Remedial use; here the issue may be quality rather than quantity.

One final word on the classification of programs according to use. Considering the federal expenditures for remedial and special education (some of which are likely to pay for software), perhaps the government should help fund an agency that would establish minimum standards for producing software suitable for use with remedial or special education students. This agency could then screen the programs available on the market and provide an independent judgment about their suitability for these special populations. The standards could be made available to software producers seeking to satisfy these markets, and the judgments made about existing programs could be made available to publishers of software directories and databases.

CONSIDERING QUALITY AS WELL AS QUANTITY IN SATISFYING SCHOOL NEED

Determining the quantity of software available for a given school subject, area, grade range, and student population is just one means of assessing whether "school needs" are being met. Unfortunately, many programs are of insufficient quality for use in the schools. Accordingly, in Chapter II, we report the results of one method of assessing the quality of educational software.

CHAPTER II

ASSESSMENT OF EDUCATIONAL SOFTWARE QUALITY

OVERVIEW

In this chapter, we assess the overall quality of educational software as well as trends in quality, based on evaluations conducted by eight agencies found to be among the most thorough. We fully recognize that any judgments about overall software quality are limited by the essentially subjective nature of the software evaluation process. These limitations are detailed in the chapter.

Finally, we compare the programs recommended by the evaluation agencies to those recommended by a group of "leading edge" teachers (i.e., those identified as effectively integrating microcomputers and software with classroom instruction).

PROCEDURE FOR DETERMINING HIGH QUALITY SOFTWARE

The measure of software quality used for this study consisted of the questions or prompts concerning specific characteristics of educational software appearing in the evaluation form and printed guidelines of an agency and publication that conducts software evaluation.

Using this measure of quality, a matrix of characteristics of educational software was developed, based on the evaluation forms and guidelines (if any) of many agencies and publications. This matrix was then refined after consulting experts in the field. (See Appendix IV for both the original and refined matrices.) Eventually, eight agencies were selected as being among the most thorough (i.e., among those that most closely match the refined version of the matrix).

Finally, the evaluations from the eight agencies were analyzed and judged as generally positive in tenor, generally negative, or balanced between positive and negative. A composite rating was assigned to each program reviewed. (For a more detailed description of the procedure used, see Appendix IV.)

LIMITATIONS TO THE PROCEDURE FOR DETERMINING SOFTWARE QUALITY

There are four important limitations to the procedure for determining software quality described above. First, there is the subjective nature of software evaluation. Perhaps the activity of the agencies chosen in this study can best be described as software reviewing, more akin to restaurant and movie reviewing than to a science. There is no agreed-upon set of well-defined criteria that a quality software program must satisfy. Even the most thorough of the evaluation agencies do not measure the learning outcomes of software programs. (And attempting to do so would raise other problems, such as specifying the conditions under which the software is used.) While thorough evaluation forms and guidelines can increase the chances of a thorough, carefully-considered review, it is, nonetheless, a subjective opinion.

Second, relatively few programs (21%) have been evaluated by even one agency, let alone a few agencies. And since many agencies rely, in part, on ads and press releases to learn about new software, more programs by larger companies with larger marketing and public relations budgets tend to be reviewed.

Third, evaluation agencies tend to be biased in favor of reviewing programs they predict will be judged positively. Few of the agencies choose programs for review at random. Most rely, at least in part, on word of mouth -- that is, someone else's judgment that a program may be of some quality. Statistics describing the quality of software are, therefore, likely to be skewed in favor of quality.

Finally, the data on negative evaluations is incomplete, further skewing the scores in favor of quality.

DATA ON SOFTWARE QUALITY

Overall Quality of Programs Reviewed

Of the programs reviewed (1,550), 59% (915) were recommended, but for the reasons cited above, we believe this to be an overstatement of the overall quality of software. Our best estimate is that 30%-40% of the programs on the market are of sufficient quality to be used in U.S. schools.

This estimate should be seen by software acquisition decisionmakers as both good news and a reason for caution. The good news is that if software is being sought to meet a curricular need, there is a good chance that at least one program of sufficient quality exists to meet that need. (The chances vary, however, from subject to subject, and from area to area.) The caution is that there are still probably more low quality programs than high; decisionmakers must be very careful in the software choices they make. To make prudent choices, decisionmakers should have access to thorough, accurate information about programs under consideration and should include local previewing as part of the decisionmaking process.

Percent of Programs Reviewed Out of Programs by Subject

Only 21% of the total number of programs were reviewed by at least one of the eight agencies. The percentages of programs reviewed for the major school subjects vary only 5%, with a range from 18% to 23%. Within the non-major school subjects, the percentages of programs reviewed range from 0% to 38%. The evaluation agencies chose to review a higher proportion of programs in Early Learning/Preschool (38%) and Logic/Problem Solving (37%) than in other non-major subjects.

Percentages of Programs Recommended Out of Programs Reviewed by Subject

The percentages of programs recommended out of the total number of reviewed programs for each subject are presented in Table 20. As was suggested for the overall percentage of programs recommended out of those reviewed, these percentages are likely to be somewhat inflated.

Within the major school subjects, the percentage recommended ranges from 49% for Mathematics to 72% for Social Science. Figure 4 presents this distribution graphically.

TABLE 20. PERCENT OF PROGRAMS RECOMMENDED (N=915) OUT OF THOSE REVIEWED (N=1550) BY SUBJECT

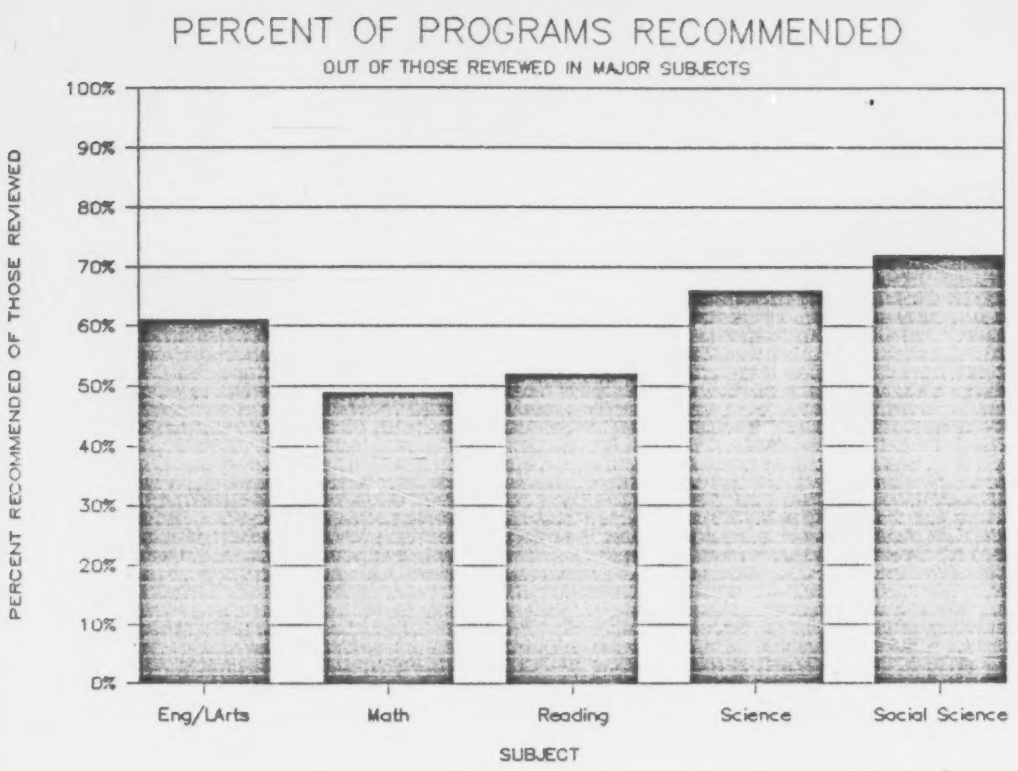
SUBJECT	NUMBER RECOMMENDED	NUMBER REVIEWED	PERCENT RECOMMENDED
Business	23	35	66%
Comprehensive	53	69	77%
Computers	40	58	69%
Early Lrning/Preschool	25	61	41%
ENGLISH/LANG ARTS (LA)	103	169	61%
Fine Arts	41	54	76%
Foreign Language	36	56	64%
Logic/Problem Solving	44	58	76%
MATHEMATICS (MA)	223	457	49%
READING (RD)	100	194	52%
SCIENCE (SC)	176	267	66%
SOCIAL SCIENCE (SS)	73	102	72%
Other**	56	90	62%
All Subjects	915*	1550*	59%

* The sum of the programs in the Number Recommended column and in the Number Reviewed column is greater than N due to the fact that some programs were assigned to more than one subject category. All percentages were rounded to the nearest unit.

** The *Other* category combines 9 subjects (Agriculture, Aviation, Driver Education, Guidance, Health, Home Economics, Industrial Arts, Library Skills, and Physical Education), each having less than 35 programs reviewed.

Source: Evaluations of educational software published through July 1987 from eight agencies: Alberta (Canada) Department of Education, Curriculum Branch Computer Courseware Clearinghouse; Connecticut Special Network for Software Evaluation (CONNSENSE); Educational Products Information Exchange (EPIE) Institute; Florida Center for Instructional Computing (FCIC); High Scope Educational Research Foundations; Microsift, Northwest Regional Laboratory; North Carolina Department of Public Instruction, Media Evaluation Services; York University (Canada) YESSUS Project.

FIGURE 4



Source: Evaluations of educational software published through July 1987 from eight agencies: Alberta (Canada) Department of Education, Curriculum Branch Computer Courseware Clearinghouse; Connecticut Special Network for Software Evaluation (CONNSENSE); Educational Products Information Exchange (EPIE) Institute; Florida Center for Instructional Computing (FCIC); High Scope Educational Research Foundations; Microsift, Northwest Regional Laboratory; North Carolina Department of Public Instruction, Media Evaluation Services; York University (Canada) YESSUS Project.

While we believe these percentages overstate the picture of quality, the variation in percentages from subject to subject does suggest a difference in quality. The higher percentage of recommended programs for Science and Social Science may be related, in part, to the fact that these subject categories also contain higher percentages of Simulations (which tend to make good use of the microcomputer's capabilities and, thus, may be recommended by evaluators more frequently than, say, Skills Practice programs).

Within the non-major school subjects the percentage recommended ranges from 41% for Early Learning/Preschool and Home Economics to 77% for Comprehensive. In most cases, 60% or more of the programs were recommended.

Percent of Programs Recommended
Out of All Programs by Subject

Before educational software acquisition decisionmakers have a chance to actually preview software, the picture of software quality they get is based, at least partially, on recommendations from reliable agencies. This picture of software quality is limited by the number of programs evaluation agencies review and then recommend. The decisionmakers learn of relatively few recommended programs out of the total number of programs for each subject, yielding a rather negative impression of software quality. Overall, 12% of all the programs were recommended.

For the major school subjects, percentages range from 11% for Mathematics to 17% for Reading. Within the non-major school subjects percentages range from 7% for Home Economics to 28% for Logic/Problem Solving (excluding Agriculture and Physical Education, subjects for which no programs were reviewed).

These percentages probably understate the true picture of quality since there are likely to be many more quality programs that were not reviewed.

Comparison of Distributions of Recommended
Programs by Subject With All Programs by Subject

In order to compare the distribution of recommended programs by subject with the overall distribution of programs by subject, a percentage of the number of recommended programs out of the total number of recommended programs was calculated for each subject.

Within all school subjects, the difference between the percentage of recommended programs and the percentage of programs in that subject is less than 4%. Thus, the percentage of quality programs by subject is reflective of the percentage of programs available in each subject. For example, the higher percentages of recommended programs in Mathematics (24%) and Science (19%) reflect the fact that there are more programs available for these subjects.

Comparison by Copyright Date Range:
Percent of Programs Recommended
Out of Those Reviewed by Subject

Percentages recommended out of those reviewed for two copyright date ranges, pre-1985 and 1985-1987, were calculated, in order to analyze trends in software quality. For all subjects, the percent recommended is 58% for pre-1985 copyrights and 77% for 1985-1987 copyrights. While both of these percentages probably overstate software quality, they do suggest an overall improvement in quality.

In all, copyright date information was provided by the software publisher for only 822 of the 1550 reviewed programs. Of these 822, 640 have pre-1985 copyrights, and 182 have 1985-1987 copyrights.

Within the major school subjects, the percentage of recommended programs has increased from the period prior to 1985 to the period 1985-1987. The most dramatic increases have been in Mathematics (35% increase), Reading (32% increase), and Social Science (27% increase). A comparison of the percentages for the two time periods is shown in Figure 5. The data suggest an improvement in quality over the last two and one half years.

Caution should be exercised in interpreting these data, as the programs chosen for review do not constitute a random sampling from the two time periods, and some biases due to the selection process may exist. Having noted this, there is no data to suggest a greater bias towards recommending programs in the period 1985-1987. If anything, standards of evaluation have probably gotten tougher over the years, and the quality and training of evaluators has probably improved.

Within the non-major subjects , the change in percentage of recommended software fluctuates widely, from a 37% decrease for Business to a 57% increase for Health. These fluctuations may be due to the small numbers of software programs reviewed in these subjects.

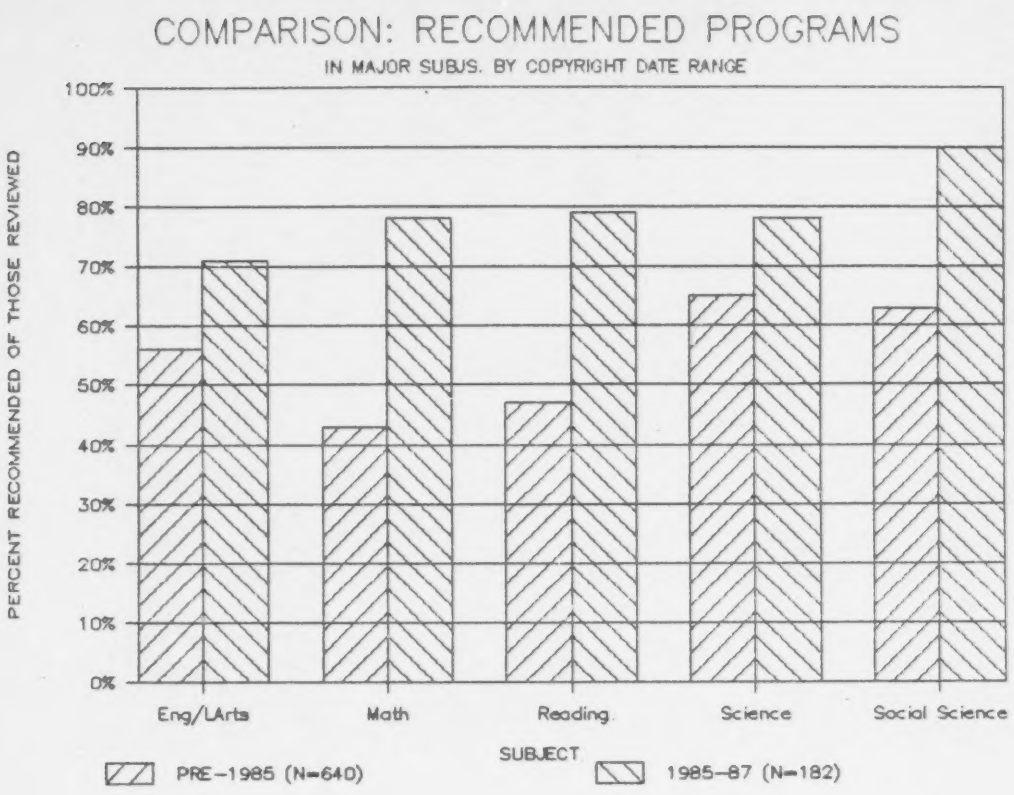
COMPARING PROGRAMS RECOMMENDED BY SELECTED EVALUATION AGENCIES TO PROGRAMS RECOMMENDED BY "LEADING EDGE" TEACHERS

An alternative approach to identifying "quality" software is to ask the opinions of teachers who have the reputation of effectively using software and microcomputers in the classroom. To explore this alternative approach, a list of programs was developed based on interviews with 12 "leading edge" teachers. An attempt was made to include teachers with a variety of content expertise and grade level experience, and from various parts of the country. These teachers were asked to name the 15 programs they have used and liked the best, and to name programs recommended by colleagues.

In all 115 programs were named by the teachers. The majority of these can be characterized as open-ended, either allowing the student a wide range of choices and decisions, or allowing the teacher to adapt the content to the student population. Of the programs named, 28% are categorized as Comprehensive (e.g., wordprocessing and database programs), 17% as Science, 15% as Logic/Problem Solving, and 12% as Mathematics. The predominance of Comprehensive software suggests that open-ended tools (especially wordprocessors) may be the most valuable programs currently available that are applicable to the Language Arts curriculum. The predominance of Logic/Problem Solving, Mathematics, and Science software may represent the subject biases of the "leading edge" teachers interviewed.

Approximately half of the programs named by the teachers are also on the list of software recommended by the eight evaluation agencies. Many of the programs named by the teachers but not recommended by the evaluation agencies are open-ended tools, some of which were not originally intended specifically for K-12 school use (e.g., Macpaint, Lotus 1,2,3). Such programs are less likely to be reviewed by agencies dedicated to evaluating specifically educational software.

FIGURE 5



Source: Evaluations of educational software published through July 1987 from eight agencies: Alberta (Canada) Department of Education, Curriculum Branch Computer Courseware Clearinghouse; Connecticut Special Network for Software Evaluation (CONNSENSE); Educational Products Information Exchange (EPIE) Institute; Florida Center for Instructional Computing (FCIC); High Scope Educational Research Foundations; Microsift, Northwest Regional Laboratory; North Carolina Department of Public Instruction, Media Evaluation Services; York University (Canada) YESSUS Project.

SOME FINAL THOUGHTS ON SOFTWARE QUALITY

The data presented in Chapters I and II present a view of educational software as product rather than process. One key to improving software quality is to examine the process of developing high quality programs and to identify the steps in the process that distinguish higher and lower quality programs.

We are confident that the process of creating high quality programs includes:

* a creative idea that combines knowledge of the computer's array of capabilities with knowledge of what will improve the teaching-learning process

* a procedure for testing a creative idea out on teachers and other education professionals, while the idea is still at the planning stage

* a procedure for translating a creative idea into a working computer program

* a procedure for identifying talented instructional designers, programmers, and graphic artists to carry out the project

* a procedure for rigorously field testing the program in the school setting for which it is intended while it is still in development, so that needed improvements can be identified and made

* a procedure for determining what support materials teachers and students will need to get the most out of the program, and for developing such materials.

We suggest that more research be undertaken focusing on the process of creating high quality programs. Then, perhaps, the government can determine which steps in the process are encouraged by the existing software market, and which steps need encouragement by other means.

One final thought -- we suggest that one appropriate government role (federal, state, and local) would be to fund the training of teachers in the effective use of educational software. Not only will suitably trained teachers be better able to use existing software effectively, they will be better prepared to integrate more sophisticated programs yet to be developed.

CHAPTER III

EDUCATIONAL SOFTWARE INFORMATION SOURCES: HOW THEY ARE PERCEIVED AND USED BY ACQUISITION DECISIONMAKERS

OVERVIEW

In this chapter, we present a typology of sources providing information about educational software. The typology describes characteristics related both to the usefulness of the data source to software acquisition decisionmakers and to the accessibility of the information.

Following the typology, we discuss how different source types might serve software acquisition decisionmakers.

As part of the process of developing the typology, interviews were conducted with a representative sample of directors or editors of evaluation agencies, to ascertain a picture of their evaluation processes and their final, published evaluations. (See Appendix V for a summary of their responses.)

In analyzing the data based on these interviews, we find some overall strengths of these services. Most of the agencies seek qualified evaluators with both subject matter expertise and computer experience. Most train the evaluators and then assign them programs based on their subject matter expertise. While we recognize the fact that software evaluation is, by its nature, a subjective process, the use of two or more evaluators per program combined with thorough evaluation forms and guidelines tend to make the end product less subjective. Most of the agencies have someone other than an evaluator edit the final published evaluation, as a form of quality control.

Perhaps the greatest limitation of the evaluation agencies is the number of programs reviewed in a given year. Approximately 2,000 new educational software programs come to the marketplace each year. No agency evaluates more than 25% of those titles, and most evaluate less than 10% of the total. And since many programs are evaluated by several agencies, the total number of programs receiving thorough evaluations is even further reduced. Even if one were to read all evaluations published by all 11 of the agencies surveyed here, chances are that well over half of the new programs would not have been evaluated by any of them.

For another point of view, representatives from State Departments of Education, large and small districts, and local schools were also interviewed to determine their role in the software acquisition decisionmaking process, and to identify what sources of information about software these decisionmakers find useful and the sources to which they have access. (See Appendix VI for a summary of their responses.)

TYPOLOGY OF EDUCATIONAL SOFTWARE INFORMATION SOURCES

How do the various sources of information about educational software compare to the needs of the acquisition decisionmakers? In an attempt to answer this question, we developed a typology of information sources and compare their ability to satisfy the needs of decisionmakers at various levels of the educational system.

The typology describes educational software data sources in terms of their usefulness and their accessibility to the public. The data sources included in the typology are as follows:

* Independent evaluation agencies (focusing on the more thorough agencies, usually government funded; non-profit, grant-supported; or for-profit)
* Independent directories or guides
* Professional journals
* Popular educational computing magazines
* Advertisements
* Catalogues
* Word of Mouth

Usefulness

In describing the usefulness of a given source, four aspects of the information source are considered: the inclusion of basic program data; the inclusion of evaluative information; the number of software programs covered; and the timeliness of the information.

Basic Program Data

We consider the extent to which basic data about a software program are supplied, and the reliability of that data. Based on the results of interviews with software acquisition decisionmakers, we judge basic data to be *complete* if it includes the intended age or grade range, the subject, a clear statement of the programs's goals, the type of software, the computer family, and a brief description of the program. If one or two items of information are missing or incomplete, we judge the basic data *moderately complete*. If much of the data is missing, we judge the basic data *incomplete*.

Reliability is judged on the independence of the source of the data and the extent to which the description of the program is edited so as to promote the software. Basic data is assigned one of three ratings: *low*, *moderate*, or *high*.

Evaluative Information

Considered here are the frequency with which evaluative information is provided, the level of detail (*low*, *moderate*, or *high*), the extent to which fieldtesting is part of the evaluative process, and the degree of bias in the evaluation (*low*, *moderate*, or *high*). While all software evaluation is somewhat subjective by nature, some organizations take steps to minimize the biases of any one individual, such as using more than one evaluator, developing thorough evaluation forms and guidelines, and providing training to evaluators. Such organizations would be considered *low* in bias. At the other end of the scale are organizations whose primary purpose in presenting evaluative statements is to promote the software; these information sources would be considered *high* in bias.

Number of Programs

For each information source type, a range of numbers of software programs is given.

Timeliness

Timeliness of the information is measured in the number of months lag between the time a typical software program is released for sale and the time information about the program is available from a given source type.

Accessibility

In describing the accessibility of a given source, we consider: acquisition decisionmaker familiarity with the source; circulation; cost; and general availability.

Familiarity with Source

Based on interviews with software acquisition decisionmakers, we rate how familiar each source type is to its potential audience (*low*, *moderate*, or *high*).

Circulation

Where the information is available, a range in circulation is provided.

Cost per Year

The range in cost per year is provided.

Availability

Based on survey data, we rate how easy acquisition decisionmakers feel it is to obtain the published information from a given source type.

Typology of Educational Software Information Sources:
Usefulness of Sources

Source Type	Basic Program Data	Evaluative Information	Number of Programs	Timeliness
INDEPENDENT EVALUATION AGENCIES	Moderately complete Reliability: high	Always provided Level of detail: high Fieldtesting: sometimes Bias: low	50-500+	6-12 month lag
INDEPENDENT DIRECTORIES OR GUIDES	Moderately complete Reliability: moderate-high	Always provided Level of detail: low Fieldtesting: sometimes Bias: low-moderate	200-7,500+	3-12 month lag
PROFESSIONAL JOURNALS	Moderately complete Reliability: high	Rarely-sometimes provided Level of detail: moderate-high Fieldtesting: sometimes Bias: low-moderate	10-125+	8-16 month lag
POPULAR EDUCATIONAL COMPUTING MAGAZINES	Moderately complete Reliability: moderate-high	Always provided Level of detail: moderate-high Fieldtesting: sometimes Bias: low-moderate	250-400	2-12 month lag
ADS	Ranges from incomplete to moderately complete Reliability: low-moderate	Sometimes provided Level of detail: low Fieldtesting: rarely Bias: high	200 and up; varies widely	No lag
CATALOGUES	Moderately complete Reliability: low-moderate	Sometimes provided Level of detail: low Fieldtesting: rarely Bias: high	10-500+	Ranges from no lag to 12 month lag
WORD OF MOUTH	Ranges from incomplete to complete Reliability: low-high	Always provided Level of detail: low-high Fieldtesting: sometimes Bias: low-high	Varies widely	Lag varies widely

Typology of Educational Software Information Sources:
Accessibility of Sources

Source Type	Familiarity with Source	Circulation	Cost per Year	Availability
INDEPENDENT EVALUATION AGENCIES	Low-moderate	5,000 or less	Ranges from no charge to $275	Low
INDEPENDENT DIRECTORIES OR GUIDES	Low	3,000-10,000	$20-$75	Low
PROFESSIONAL JOURNALS	Moderate	5,000-160,000	$15-$50	Low-moderate
POPULAR EDUCATIONAL COMPUTING MAGAZINES	High	45,000-82,000	$16-$24	High
ADS	High	Varies widely	Not applicable	High
CATALOGUES	High	Varies widely	No charge	High
WORD OF MOUTH	High	5-500+	Ranges from no charge to $300+	High

HOW DIFFERENT INFORMATION SOURCE TYPES MIGHT SERVE SOFTWARE ACQUISITION DECISIONMAKERS

The characteristics of the different source types suggest different uses for them throughout the software acquisition process. We view the acquisition process as consisting of at least five steps:

1. Determining software needs (e.g., subject, area, and topics; type, grade or age range)

2. Identifying programs that potentially meet those needs

3. Gathering evaluative information about the programs identified above

4. Previewing programs that have been evaluated positively, including fieldtesting with students, if possible

5. Selecting the program(s) that seem to most closely meet the needs specified, after previewing

The information sources described in the typology above have a role to play in steps 1-3.

Determining Software Needs

The ability of an acquisition decisionmaker to determine software needs is dependent on his or her general knowledge of what software and microcomputers can deliver. One might reasonably expect representatives of State Departments of Education, and large and small school districts to develop such a general knowledge, typically found in professional journals and popular educational computing magazines. Word of mouth, in the form of lectures, is another useful source. Other sources, not covered in our typology, include published books, and conference papers.

Identifying Programs

In large districts (over 10,000 students), the task of identifying programs for further consideration is, perhaps, most effectively left to district-level personnel, with advice from local school personnel. In smaller districts, local school personnel may have to identify the programs. The best source type to begin with here is the independent directories or guides. They allow quick access to data about many different programs. And because they incorporate evaluative information from other agencies (e.g., by including review citations), they aid in the selection process. (This source type was rated *low-moderate* in bias because the evaluation agencies relied upon vary in the steps they take to screen out evaluator bias.)

One problem with independent directories and guides is that they are not always up-to-date. The very latest programs available on the market are often not included. To access information about the very newest programs, decisionmakers might reasonably make use of popular educational computing magazines, advertisements, catalogues, and in some cases, word of mouth. It is essential that decisionmakers keep in mind the high degree of bias in ads, catalogues, and in some case, the new software listings sections of popular magazines. Even the independent directories and guides rely upon data supplied by the software publishers (e.g., grade range specification, licensing policy[19]).

---

19. See Appendix VII for additional information about software publishers' licensing policies.

Another problem with independent directories and guides is that they are unavailable to large numbers of acquisition decisionmakers.

Gathering Evaluative Information

Depending on the philosophy of the school district, gathering evaluative information will likely be carried out by district-level personnel, by local school personnel, or by some combination of the two. This step is especially important if there are many different programs that might potentially meet an identified school need, or if a school district does not have trained, highly experienced software evaluators on staff. The most objective sources are the more thorough independent evaluation agencies. Professional journals might be consulted for a subject-specific or population-specific point of view. One limitation of these two source types is the relative small number of programs reviewed per year (typically 50-150 for independent agencies, and even less for professional journals). This problem is made worse by the processes typically used to acquire software for evaluation. With the heavy reliance on magazine ads, press releases, and word-of-mouth when deciding what software to acquire, the products of the larger software publishers, with their larger marketing and public relations budgets, are more likely to get reviewed. This is probably true even though most agencies do not intentionally focus on the programs of larger publishers.

In addition, neither the independent evaluation agencies nor the professional journals are likely to be as up-to-date as the popular educational computing magazines; these magazines are also much more likely to include comparisons of many different programs targeted for the same subject, area, topic, and student population. Magazines also issue special awards to a handful of programs each year; decisionmakers must carefully explore the procedures used in issuing such awards.

No matter how thorough an evaluation is, it cannot take the place of local previewing and fieldtesting. Few of the sources of evaluation consistently incorporate fieldtesting as part of the review process.[20] (Only half of the agencies conduct field testing on a regular basis, but few have a standard system of data collection.) And local needs are apt to be somewhat unique.

SUGGESTIONS FOR A GOVERNMENT ROLE IN THE DISSEMINATION OF INFORMATION ON EDUCATIONAL SOFTWARE

There is potential role for government in the dissemination of basic data about education software, the dissemination of evaluative information, and in training of educational professionals in the use of the available information sources.

Dissemination of Basic Program Data

There is a need for a centralized directory of educational software. It should be easy for all educational software publishers, whether large or small, to have programs included in the directory. Whether in printed or online form, such a directory should be widely available to school software acquisition decisionmakers, and it should be inexpensive.

---

20. See Appendix VII for additional information about software publishers' previewing and fieldtesting policies.

There appear to be three major costs connected with developing and maintaining a software database or directory. First, there is the cost of constantly updating the system: keeping track of new programs, revised programs, and programs no longer on the market. Second, there is the cost of developing and maintaining a search system sufficiently sophisticated (e.g., utilizing Boolean logic) to support the needs of both consumers and researchers. Third, there is the high cost of disseminating information about the database so that potential users will take advantage of the resources. These problems indicate a potential need for government assistance in this area.

Ideally, such a directory would also include a comprehensive list of review citations. Currently, different guides and directories use different combinations of sources -- sources that vary widely in the thoroughness of their evaluations.

Dissemination of Evaluative Information

The general availability of the most thorough educational software evaluations is a major problem. When looking at the educational community as a whole, only an extremely small portion is served by the agencies that produce these evaluations. In some cases, price is an issue; some evaluation services are too expensive to get in the hands of local school personnel, who make many of the final acquisition decisions. In other cases, the service may even be free of charge, but the added cost of dissemination to the local level has not been taken into account. In still other instances, evaluations are generally available within a single state or region, but not to other states or regions. If the government judges that these more thorough sources should be available to acquisition decisionmakers (especially at the district and local levels), it may want to consider subsidizing the cost of dissemination.

The data collected for this study also suggests that decisionmakers would especially appreciate evaluations based on subject-specific forms and guidelines, including comparisons of similar products. The government may want to fund the development of the necessary forms and guidelines, as well as procedures for making program comparisons.

There is also a need to coordinate the evaluation of software so as to avoid unnecessary duplication of effort and to increase the number of programs about which evaluative information is available.

Training

The survey data indicates that many decisionmakers are not familiar with many of the data sources available. Note that the local school personnel we interviewed are likely to be more familiar with software and are likely to have had more experience using computers than the average teacher. Government (federal, state, and local) has a role to play in the training of education professionals concerning the careful selection of software. We envision training in the use of all available data sources, focusing on the specific role a professional plays in the software acquisition process, and the corresponding information needs of that professional.

APPENDIX I

A COMPARISON OF THE THREE DATABASES USED FOR THIS STUDY

The Educational Software Selector (TESS) database, by the Educational Products Information Exchange (EPIE) Institute, was the primary information source used in Chapter I of this report. For purposes of comparison, .MENU -- The International Software Database (.MENU), by the International Software Database Corporation, and The Microcomputer Software and Hardware Guide (MSHG) database, by R.R. Bowker, accessible via DIALOG, were also searched utilizing subjects identified in the TESS database.

All comparisons between databases are made using percentages alone, due to the fact that categories in two of the databases (TESS and MSHG) are not mutually exclusive. Because both TESS and MSHG assign some programs to more than one subject or grade range, statistical analyses using Chi2 distributions are inappropriate. This decision was made in consultation with a statistician.

COMPARISONS REGARDING DISTRIBUTION OF SOFTWARE BY SUBJECT

The MSHG database includes 2,090 software programs that are categorized with descriptors comparable to the subjects and areas used in TESS. We were able to group descriptor categories into sets that were roughly comparable to the categories for the major school subjects, plus Agriculture, Business, Computers, Driver Education, Fine Arts, Foreign Language, Health, Home Economics, Industrial Arts, Library Skills, and Physical Education. In this database as well, the larger percentages of software fall within the major school subjects. These percentages range from 27% for Mathematics to 9% for Social Science. Within all non-major school subjects, all categories represent 5% or less of the software in the database.

The .MENU database contains 4,216 software programs that are categorized with descriptors comparable to the subjects and areas used in TESS. In this database, we were able to group descriptor categories into sets that were roughly comparable to the categories for the major school subjects, plus Computers and Foreign Language. However, since .MENU provides no way to specify the grade range being sought, some of the programs counted may not be appropriate for grades K-12. Once again the larger percentages of software fall within the major school subjects. These percentages range from 25% for Mathematics to 12% for English/Language Arts.

Comparison of Databases for Major Subjects

The overall distribution is the same for all three databases, with two exceptions. The TESS database has a slightly higher percentage of Mathematics programs (36% compared to 31% for the other two databases). And .MENU appears to have a higher percentage of Social Science programs (16% compared to 10% for the other two databases). This difference in Social Science programs may be somewhat spurious, since .MENU uses mutually exclusive categories, whereas in TESS and MSHG, a program may be assigned to more than one school subject. This lack of mutual exclusivity with respect to categories makes it impossible to determine whether these differences are statistically significant.

Comparison of Databases for Non-major Subjects

We were able to construct descriptor sets in MSHG to form categories for the following non-major school subjects found in TESS:

Agriculture
Business
Computers
Driver Education
Fine Arts
Foreign Language
Health
Home Economics
Industrial Arts
Library Skills
Physical Education

There are five additional non-major subjects listed in TESS for which descriptor sets in MSHG could not be constructed. For both databases, none of these non-major school subject categories represents more than 5% of the software programs.

We were able to organize descriptor sets in .MENU to form only two comparable non-major school subjects: Computers and Foreign Language. For .MENU, 6% of the programs are classified as Computers, and 10% are classified as Foreign Language. These percentages may be higher than those for the other databases because they are the only two comparable non-major subjects. The fact that .MENU is an international database may account for the relatively high percentage of Foreign Language programs. In any event, due to the relatively low percentages for non-major subjects in all three databases, no further comparative analysis was undertaken.

Additional categories exist in TESS for which no descriptor sets could be constructed in MSHG or .MENU to facilitate comparisons.

Comparison of Databases for Major Subjects by Grade Range

In order to examine how the software programs categorized as major school subjects are distributed across grade levels, percentages of software for Kindergarten, Grades 1-3, Grades 4-6, Grades 7-8, and Grades 9-12 were calculated for both the TESS and MSHG databases. (.MENU is not categorized by grade level.)

In comparing the databases, the distribution of software by grade level is relatively similar. In both TESS and MSHG, the smallest percentage of programs are listed for Kindergarten. A large percentage of programs are listed for grades 7 through 12, with TESS containing a higher percentage for grades 9 through 12. MSHG contains the largest percentage of programs for grades 4 through 6.

Differences between the grade level distributions may be due to the fact that data in MSHG, with respect to this variable, are reportedly incomplete and inconsistent. According to an R.R. Bowker representative, grade level information is currently being revised and updated for the educational portion of the database.

CHOOSING TESS FOR THE REMAINDER OF THE STUDY

While there are slight differences between the three databases across subjects, the overall distribution of software appears to be relatively the same. When TESS and MSHG are compared across grade ranges, again the overall distribution is similar with slight differences in the 4-6 grade range and the 9-12 grade range.

The TESS database is similar to the other two databases but EPIE (the producer of the database) was able to provide IESD analysts with access to their most up-to-date information (current as of July 1987) about a larger body of programs.

In both .MENU and MSHG, the descriptors used to categorize educational software by subject and area are more general and less complete than those in TESS. For the major subjects English/Language Arts, Mathematics, Reading, and Science, the TESS database had more programs listed. The one exception is in Social Science, where .MENU had more programs listed than TESS, but this difference is slight (565 programs for TESS to 572 programs for .MENU, which may include some programs not appropriate for grades K-12).

The most serious problem with the .MENU database is that school subjects cannot be searched by grade range. No grade appropriateness data are included. And in MSHG, the data concerning grade range are reportedly incomplete and inconsistent. In personal communication with a MSHG representative, it was revealed that for many educational programs no grade range information is currently included. Any careful analysis of the scope of the educational software market requires accurate, up-to-date grade range information. With respect to this type of information, the TESS database is clearly the most complete.

One of the continuing problems in using databases is the timeliness of the data. There is typically a delay from the time updated information about software programs is received from the software publishers to the time the data is available to the general public online. In the case of the TESS database, we were provided access to the most up-to-date version of the database -- a version not yet available to the general public. Since the educational software portions of both .MENU and MSHG are undergoing major revisions, up-to-date information is available neither in an in-house version nor in the commercially-available version. Therefore, the in-depth analyses performed for this study use only the TESS database. (See Appendix II for a comparison of TESS and MSHG with respect to data about the cost of educational software.)

APPENDIX II

COMPARISON OF THE EDUCATIONAL SOFTWARE SELECTOR (TESS) AND THE MICROCOMPUTER SOFTWARE AND HARDWARE GUIDE (MSHG) DATABASES: DISTRIBUTION OF PROGRAMS BY COST

For the TESS database, only one cost figure is available for each program, even though for some programs, there is more than one price for different computer family versions of the program. When this occurs, the price listed in TESS is the price for the Apple II family version. The MSHG database, alternatively, lists more than one price for some programs, sometimes including the price of supplementary print materials. Since supplementary print materials such as manuals and teachers guides are usually priced under $50, this appears to have inflated the number of programs available in the lowest cost range for the MSHG database.

The largest percentage of software for both TESS and MSHG falls within the $1-50 range (57% and 73%, respectively). Twenty-nine percent of the software in TESS and 26% of the software in MSHG fall within the $51-$100 category. Less than 5% of the software in TESS falls into any of the cost ranges above $100. For MSHG, 7% of the software falls into each of the $101-$150 and $151-$200 ranges.

The data from both databases suggest that the majority of the educational software programs are priced at $50 or less, with over 85% priced at $100 or less, and very few costing more than $200.

APPENDIX III

SAMPLING STRATEGY FOR COLLECTION OF DATA FROM STATES CONCERNING "SCHOOL NEED"

In an attempt to identify "school need" from the point of view of State Departments of Education, a sample of ten states was selected in consultation with the Education Commission of the States to be representative of various geographic regions and such various socio-economic considerations as racial/ethnic mix in the population, industrial bias, and mix of household income levels. These states were then contacted and asked to send information pertaining to their curriculum requirements and (if available) specific curriculum materials and software needs. In addition, within each state's Department of Education, we contacted the Division of Curriculum Services requesting:

- any existing reports on the needs for curriculum materials and educational software
- any existing reports on the percentage of time (either required by the State or by representative districts in the State) to be spent on each subject area by grade level.
- a list of subject matter to be covered by grade level.

The ten states originally targeted are listed below by region.

North-Eastern States

Massachusetts
New York
Maryland

Midwest and Western

Ohio
Minnesota
Colorado
California

Southern

Texas
Florida
Mississippi

We received material from five of these states: New York, Ohio, Minnesota, California, and Mississippi. In order to increase our coverage to at least two or three states in each of the three regions, we substituted three additional states -- Pennsylvania, Connecticut, and Virginia.

The following summarizes information collected through our contact with each state.

NORTH-EASTERN STATES

Massachusetts: We contacted the Bureau of Educational Resources and learned that there are no state guidelines available. Each school department sets up its own curriculum guidelines. Therefore, no information was collected from Massachusetts.

New York: We received the *Regents Action Plan for Elementary and Secondary Education Results* outlining state guidelines and requirements for instruction and graduation.

Maryland: We contacted the Division of Instruction and learned that each of Maryland's school districts is independent. The state has no overall set of curriculum guidelines. At best, the Division of Instruction has published a broad set of suggestions for Social Studies, Art, Physical Education, and Mathematics. We were advised that this publication would not meet our needs.

Pennsylvania (substituted for Maryland): We received the State Curriculum Regulations.

Connecticut (substituted for Massachusetts): We received the curriculum guides for Mathematics, Language Arts, Foreign Language, and Physical Education. (Others are currently being revised and are not available.) We also received the state document on policies, practices, and procedures covering all grades and subjects.

MIDWEST AND WESTERN STATES

Ohio: We received Minimum Standards report for elementary and secondary schools.

Minnesota: We received the Learner Outcome Guidelines for elementary and secondary schools.

Colorado: The state's Curriculum Guidelines are currently being revised and as a result, are not readily available.

California: We received the Curriculum Guidelines for K-8 and Curriculum Standards for 9-12.

SOUTHERN STATES

Texas: We contacted the Bureau of Curriculum Services and learned that the only frameworks available now are in Social Studies and Mathematics. An order for these would have taken too long to process for us to receive the data in time for inclusion in this study.

Florida: We contacted the Bureau of Curriculum and learned that Curriculum Frameworks are the only source of the required information and are available only for grades 6-12. As in Texas, an order for these would have taken too long to process for us to receive the data in time for inclusion in this study.

Mississippi: We received the Curriculum Structure: Philosophy, Goals, Skills and Concepts report.

Virginia (substituted for Texas and Florida): We received the Standards for Learning Objectives for grades K through 12.

APPENDIX IV

PROCEDURE FOR DETERMINING HIGH QUALITY SOFTWARE

In this Appendix, the procedure used to determine high quality software programs is described in detail. The procedure involved the development of two matrices based on characteristics considered by agencies that evaluate educational software. Our goal was to identify the more thorough agencies and then use their judgments about educational software as a basis for identifying high quality programs. The two matrices are presented at the conclusion of this Appendix.

DEVELOPING AND REVISING A MATRIX OF SOFTWARE CHARACTERISTICS

Thirty-six evaluation agencies were selected for analysis, representing a broad spectrum of purposes and funding sources. The evaluation agencies include: government funded projects; state and local education organizations; non-profit, private institutions; university-based projects; professional publications; and for-profit publications not affiliated with a software publishing firm.

Each agency's evaluation form and guidelines (if any) used by evaluators when considering a software program was reviewed to compile an initial summary matrix of software characteristics. In developing this initial matrix, the same characteristic was often described using different words in different forms and guidelines. Questions or prompts that were worded so generally or vaguely as to be difficult to interpret were eliminated.

We consulted with a group of professionals with a wide range of experience in creating, evaluating, and using educational software, to add to the list of characteristics and to identify important characteristics already on the list. The group consisted of: teachers reputed to be effective users of software; software publishers with a reputation for producing quality programs; university professors and private consultants with expertise in the development or evaluation of educational software, or in the training of teachers to use software. We also referred to research by Bitter and Wighton on criteria typically used by evaluation agencies+. The resulting matrix of characteristics is presented in Matrix 1 in this Appendix.

In an attempt to pare down the matrix, we eliminated those characteristics that were included by less than 50% of the evaluation agencies and not mentioned by the group of experts. The resulting list is presented in Matrix 2 in this Appendix, which also identifies (with a dash), the characteristics mentioned by more than half of the agencies. The characteristics mentioned by the group of software experts described above are marked with an asterisk (*).

A total of 129 characteristics were included in the revised list. Of these only 13% were mentioned by more than half of the agencies. These characteristics constitute a minimal level of acceptability for educational software (e.g., content is accurate; program is "bug-free"). They tend to be general in nature.

+ Gary G. Bitter and David Wighton, The Most Important Evaluation Criteria Used Within the Educational Software Consortium, an unpublished paper prepared for the Educational Software Evaluation Consortium, 1986.

Alternatively, the additional characteristics mentioned by the group of software experts tend to focus on the specific, especially in three areas:

- Specific characteristics of effective instruction that make it more likely that learning will occur (e.g, logical sequencing of instruction).

- Specific capabilities of the microcomputer that can be exploited for effective instruction (e.g., branching, random generation)

- Specific problems of using computers as part of actual classroom instruction (e.g., using a program in a classroom with one computer vs. using it in a computer lab).

The list of characteristics is not meant to be used as a checklist for quality software. Not all of the characteristics apply to all types of software. In addition, the software experts stress that subject-specific and student population-specific characteristics ought to be considered as well.

For example, typing experts recommend that high quality typing software include instruction on proper finger position, speed control, saved records that track both speed and accuracy. Special education experts note that the ability to control the rate of presentation is a must for software to be used with learning disabled students.

SELECTING AGENCIES FOR FURTHER ANALYSIS

To select the evaluation agencies that would be included for further analysis, not only was the revised list of characteristics considered, but also data concerning the evaluation process itself. Preference was given to agencies that have a standardized training procedure for evaluators, that use two or more evaluators per project, and that have an editor or writer to check on the accuracy and consistency of the information provided by the evaluators. A few agencies were eliminated from consideration because they do not publish reviews of individual software programs. Some agencies were eliminated because complete, reliable data concerning their evaluation processes could not gathered within the time limitations of this study.

Eleven agencies stood out as having a more thorough evaluation procedure than the others. These include:

- Alberta Department of Education, Curriculum Branch Computer Courseware Clearinghouse (Canada)
- California Technology in the Curriculum (TIC) Projects
- Connecticut Special Education Network for Software Evaluation (CONNSENSE)
- Educational Products Information Exchange (EPIE) Institute
- Florida Center for Instructional Computing (FCIC)
- Florida Diagnosis and Learning Resources System, Instructional Technology Services Project (FDLRS/TECH)
- High Scope Educational Research Foundations
- Microsift (Northwest Regional Laboratory)
- North Carolina Department of Public Instruction, Media Evaluation Services
- Software Reports
- York University (Canada) YESSUS Project

Of these, three could not be included for further analysis, primarily due to time limitations: the California TIC Project, FDLRS/TECH, and Software Reports. Data collected from the remaining eight agencies are used throughout the rest of the study.

COMPARING THE CHARACTERISTICS CONSIDERED BY SELECTED AGENCIES TO THE REVISED MATRIX OF CHARACTERISTICS

To give a sense of how the software characteristics considered by these eight agencies compare to the model of evaluative thoroughness (suggested by the revised matrix of characteristics), those characteristics that more than half of the eight included in either the evaluation form or accompanying guidelines (if any) were tallied. Approximately half of the characteristics were identified, and these are marked with a plus sign in Matrix 2. We will consider these characteristics the ones "commonly" included by the selected agencies.

Note that the agreement between the commonly-considered characteristics and the revised matrix is particularly high for characteristics related to graphics and audio, feedback, and content. None of the characteristics concerning evaluators' field test results were commonly considered.

A few of the agencies have developed specific evaluation forms for wordprocessing and database programs. Only one of the eight has developed other subject-specific forms (EPIE). (It should be noted that the California TIC Project, not included due to time limitations, also utilizes subject-specific forms.) Two of the selected agencies (CONNSENSE and High Scope) focus their efforts on specific student populations (Special Education and children ages 3-6, respectively) and, thus, have developed population-specific materials.

ASSESSING SOFTWARE QUALITY BASED ON PUBLISHED EVALUATIONS

Evaluations from the eight agencies selected were analyzed and judged as generally positive in tenor, generally negative, or balanced between positive and negative. Positive reviews were given a score of +1, negative reviews a score of -1, and neutral reviews a score of 0.

Exceptions

There were some important exceptions to this procedure. Some of the agencies do not publish negative reviews and could not supply a list of the programs that would have been scored -1 in this study. Some have changed their policy over time, so that negative reviews are available for some programs but not others.

In addition, two of the agencies have specific institutional biases that might cause a software program to be rejected when it is, in fact, of high quality. The Alberta Department of Education project requires that a software program be appropriate for use in Alberta, Canada schools. Thus, the content presented and approach taken in each software program must coincide with the content presented and approaches taken in Alberta. Similarly, CONNSENSE requires that a program be suitable for special needs students. Because there are quality programs that do not meet these special criteria established by Alberta and CONNSENSE, it was decide to not include negative reviews by these two agencies.

Determining Net-positive Scores

For each K-12 software program listed in the TESS database, the review scores (not including the Alberta and CONNSENSE negatives) were tallied to yield a net score. Programs with a net-positive score were considered high quality.

MATRIX 1

CHARACTERISTICS CONSIDERED IN EVALUATING EDUCATIONAL SOFTWARE*

Content

- Content is appropriate for intended student population.

- Content is accurate.

- Content is current.

- Content breadth is reasonable (does not focus on too few or too many different concepts or content topics within one session).

- The processes and information learned are useful in domains and situations other than the subject area of the program.

- Content is free of grammar, spelling, punctuation and usage errors.

- Content is free of any bias or stereotyping.

- Content supports the school curriculum.

- Content is relevant to the subject field.

- Definitions are provided when necessary.

- There is continuity between information presented and prerequisite skills required.

- Content avoids taking a side on potentially controversial moral or social issues.

- There is a need for better than the standard treatment of this topic in the curriculum.

Simulations

- Simulation model is valid and neither too complex nor too simple for intended student population.

- Variables used in the simulation are the most relevant.

- Variables in the simulation interact and produce results approximately as they would in real life.

- Assumptions are adequately identified.

- Program simulates activities that can be too difficult, dangerous, or expensive to demonstrate in reality.

Instructional Quality/Methodology

General

- Program is useful in a school-based, instructional setting (i.e., in a classroom, computer lab, media center, or school library).

- Program avoids potentially controversial, non-standard teaching methodologies.

- Program allows completion of a lesson in one class period (approximately 30 minutes).

- Instruction is integrated with previous student experience.

- Program is likely to save time for the student when compared to other means of presenting this topic.

- Program is likely to save time for the teacher when compared to other means of presenting this topic.

- An on-disk tutorial concerning the program's command structure is provided when appropriate (e.g., for a wordprocessing program).

Appropriateness

- Application is well suited to computer use.

- The pedagogic approach used is superior to what is available elsewhere.

- Readability level is appropriate for the intended student population.

- Tone of address is appropriate for the intended student population.

- The means of response (e.g., single keystroke, manipulating graphics) is appropriate to the intended student population .

- Prerequisite skills required are appropriate for the intended student population.

- Time required for use by a typical student does not exceed the attention span of that student.

- Multiple levels of instruction are available.

- Difficulty levels are based on discernible logic (e.g., reading ability, complexity of problems).

- Sufficient exposure and practice are provided to master skills.

- Sufficient information is presented for intended learning to occur.

- Color discrimination is necessary to use program effectively.

- Hand-eye coordination is required to use program effectively.

Questioning Techniques

- Questions are appropriate to the content and effectively measure student mastery of the content.

- Questions incorrectly answered can be repeated later in the lesson/exercise.

- The number of trials are reasonable and appropriate (e.g., student receives the correct answer after no more than three or four trials, and after at least two trials).

- Calculations can be accomplished easily on-screen when appropriate.

Approach/Motivation

- Approach is appropriate for the intended student population.

- Format is varied.

- Overall tenor of interaction is warm, friendly and helpful.

- Student is an active participant in the learning process.

Evaluator's Field Test Results

- Student understands the on-screen presentation, and can proceed without confusion or frustration.

- Student enjoys using the program.

- Student retains a positive attitude about using the program.

- Student retains the desire to use the program again, or to pursue the topic in other ways.

- Program involves students in competition in a positive way.

- Program fosters cooperation among students.

Creativity

- Program challenges and stimulates creativity.

- Pedagogy is innovative.

- Program allows the student as many decisions as possible.

- Program provides opportunities to answer open-ended questions and provides evaluative criteria to assess responses.

- Program demonstrates a creative way of using knowledge.

- Program challenges the student to alter an underlying model, or design an alternative model.

Graphics and Audio

- Graphics and audio are used to motivate.

- Graphics and audio are appropriate for the intended student population.

- Graphics, audio and color enhance the instructional process.

- Graphics help focus attention to appropriate content and are not distracting.

- Program avoids using uncontrollable audio responses to student errors.

Learner Control

- Learner can alter program sequence and pace.

- Learner can review instructions and previous frames.

- Learner can end activity anytime and return to main menu.

- Learner can enter program at different points.

- Learner can stop in the midst of an activity, and at a later session begin at that stopping point with the previous record of progress intact.

- Help is available at likely points of need.

Learning Objectives, Goals, and Outcomes

- Learner objectives are stated and purpose is well defined.

- Steps are taken to make learning generalizable to other situations.

- For programs requiring use over several days, learning outcomes are worth the time invested.

Feedback

- Feedback is positive.

- Feedback is appropriate to the intended student population and does not threaten or inadvertently reward incorrect responses.

- Feedback is relevant to student responses.

- Feedback is timely.

- Feedback is informative.

- Feedback is corrective when appropriate.

- Feedback remediates and/or explains when appropriate.

- Feedback employs a variety of responses to student inputs, and avoids being boring or unnecessarily detailed.

- Feedback remains on the screen for an appropriate amount of time.

- Branching is used effectively to remediate.

- Program uses branching to automatically adjust difficulty levels or sequence according to student performance.

Clarity

- Procedural and instructional statements are clear.

- On-screen prompts clearly indicate where user should focus attention.

- Frame formatting is clear, uncluttered, and consistent from screen to screen (e.g., screen input is restricted to a consistent location).

- Presentation of each discrete content topic is logical.

- Sequence of content topics and instruction is logical and in appropriate steps.

- Sequence of menu items is logical.

- Prompts and cues are clear and consistently and logically applied.

- Hints are clear and not misleading (e.g., length of spaces in fill-in blanks matches number of letters needed, incorrect responses are well-chosen).

- Demonstrations and examples are clear and available when appropriate.

- Interface is simple enough to be used with little or no reading of the documentation.

- Program makes it clear to the user where s(he) is in the program (e.g., question number, page headings).

- User-computer communication is consistent and logical.

- Prompts to save work are given when appropriate.

Simulations

- The time needed to complete both a step and the entire simulation is reasonable and effective.

- Encourages decision-making or calculation rather than guessing.

Teacher Modifiability

- Teacher can easily change or add content.

- Teacher can easily regulate parameters (e.g., number of problems, rate of presentation, percentage correct needed for mastery) for each class using the program.

- Teacher can easily regulate parameters (e.g., number of problems, rate of presentation, percentage correct needed for mastery) for each student.

- Parameter set-ups can be by-passed (e.g., default settings are available).

Evaluation and Recordkeeping

- Program provides an adequate means of evaluating student mastery of the content.

- If tests are included, criteria for success are appropriate for the ability/skills of the intended student population.

- If tests are included, content accurately reflects the material presented.

- Scorekeeping and performance reports are provided for the student when appropriate. (e.g., summary of problems correct/number attempted, running point totals).

- Useful information about student performance is stored for future retrieval.

- Useful diagnostic pre-test or placement test is provided, where appropriate.

- Useful diagnostic or prescriptive analysis of student performance is available to the teacher, when appropriate.

- Student performance information is easily accessible to the teacher.

- Management system includes adequate security.

- Program allows printout and screen display of student records.

- Program can hold multiple performance records of a single class (e.g., 35-50 students).

- Program can hold multiple performance records of several classes (e.g., up to 5 classes) arranged by class.

Documentation and Support Materials

- Quality of the packaging is durable and appropriate for student use (e.g., not too large to be used at a microcomputer station).

- Student, parent or teacher guides and materials are clearly identified as such.

- Technical and operational explanations for implementation are clear and complete.

- If appropriate, "quick start-up" section is included.

- Useful reproducible student worksheets are provided.

- Other valuable support materials are provided (e.g., wall charts).

- Content is listed when important or when it would be helpful.

- Sample screen-by-screen printouts of the program are provided.

- Teacher support materials can be separated from student materials.

- Useful suggestions are provided for introductory classroom activities.

- Useful suggestions are provided for classroom activities during the use of the program, where necessary or helpful.

- Useful suggestions are provided for follow-up activities.

- Useful suggestions are given for classroom logistics in a variety of hardware situations (e.g., single or multiple machines) and student groupings.

- Useful suggestions are provided on how to integrate program with the regular curriculum.

- If the program is open-ended, subject-specific suggestions are included.

- Clear explanations of the differences between the various difficulty levels are provided.

- Prerequisite skills are clearly stated.

- Accurate and clear description of instructional activities are provided.

- Accurate and clear descriptions of content topics are provided.

- Where appropriate, a description of how material correlates to standard textbook series is provided.

- Necessary information can be found quickly and easily (e.g., contains index, table of contents, etc.).

- Quick reference card for program use is included, where appropriate.

- Printed text is clear and readable.

- Printed graphics are clear and readable.

- Printed text is free of errors in spelling, grammar, punctuation and usage.

Simulations

- Description of the model used in the simulation is clear, accurate and complete.

- The way variables work are described well.

Technical Quality

- Audio can be adjusted (i.e., turned down or off).

- Audio is clear and used effectively.

- Character sets used in text display are clear, appropriate, and visually interesting.

- Graphics are acceptable on a monochrome monitor.

- Graphics are clear and can be easily interpreted.

- Program is "crash-proof".

- Program runs consistently under all normal conditions and is "bug-free".

- Program runs without undue delays (e.g., graphics fill in a timely manner, does not excessively access disk drive).

- The transitions between screen displays are effective (e.g., text changes).

- Program guards against multiple key presses advancing the student past the next screen (e.g., leaning on return key and thereby missing several screens as they flash by).

- Program avoids unnecessary or inappropriate moving back and forth between screens (e.g., from page to feedback or data pages).

- Special features (e.g., flash, inverse, scrolling, split screen) are used appropriately and effectively.

- Program requires a minimal amount of typing (except typing programs).

- Random generation or selection is used when appropriate (e.g., to allow repeated use by varying the problems or data presented).

- Program judges responses accurately and accounts for minor variations in the format of the input (e.g., accepts either the correct word or letter choice in a multiple choice item).

- Program allows user to correct answers before being accepted by the program.

- Program accepts partial answers as correct whenever appropriate.

- Where students must input responses, inappropriate keys are disabled.

- Control keys are used consistently.

- Students require a minimum amount of teacher supervision while using the program when appropriate.

- Computer (and peripherals) operation does not interfere with concentration on activity.

- Program makes effective use of peripheral devices (e.g., joysticks) for alternate input modes while still allowing keyboard input.

- Program explores a previously unexplored potential of the computer or greatly expands an existing capability (e.g., new animation technique, digitized speech).

- Program uses other technologies (e.g., audio cassette, videodisc, videotape) to enhance learning when appropriate.

- Print capability is included, when appropriate.

- Printing is easy and simple to accomplish with a variety of popular printers.

Start-up and Implementation

Teacher:

- Software code modifications or unusual manipulation of disks are not required to use program effectively.

- Start-up time for teacher implementation is not excessive.

- Teacher needs a minimum of computer competencies to operate program (e.g., does not require installing add-on boards).

Student:

- Start-up time for student implementation is brief enough to permit completion of a lesson.

- Students need a minimum of computer competencies to operate program (e.g., does not require use of control-key combinations).

Probeware and Peripherals Included in the Software Package

- Probes or peripherals are durable.

- Probes or peripherals are sensitive.

- Audio and/or graphic quality are effective.

- Probes or peripherals are easy to install.

- Calibration is accurate and easy.

- Data displays are flexible (e.g., can be scaled, redrawn).

- Data analysis is useful.

Hardware and Marketing Issues

- Potential usefulness of the program justifies its price in comparison to other similar products.

- Peripherals (not included in the package) that are difficult to acquire or inappropriately expensive are not required.

- Producer field test data are available.

- Field test data indicate that students learned more or better, or had a better attitude toward the subject matter, as a result of using the program.

- Preview copies are available.

- Back-up copies are provided.

- Adequate warranty is provided.

- Telephone support is available.

- If allowable, multiple loading is possible.

- Site license is available.

- Network versions are available.

- Multiple copies discount available.

==========

* Many of the educational software experts consulted in the compiling of this list felt that subject-specific and population-specific characteristics would have to be considered for a thorough evaluation.

MATRIX 2

COMMONLY-INCLUDED CHARACTERISTICS AND CHARACTERISTICS JUDGED IMPORTANT IN EVALUATING EDUCATIONAL SOFTWARE

Content

-#+ Content is appropriate for intended student population.

-#+ Content is accurate.

#+ Content breadth is reasonable (does not focus on too few or too many different concepts or content topics within one session).

#+ Content is free of grammar, spelling, punctuation and usage errors.

-#+ Content is free of any bias or stereotyping.

-#+ Content supports the school curriculum.

\# Definitions are provided when necessary.

\# There is continuity between information presented and prerequisite skills required.

Simulations

#+ Simulation model is valid and neither too complex nor too simple for intended student population.

\# Variables used in the simulation are the most relevant.

\# Assumptions are adequately identified.

#+ Program simulates activities that can be too difficult, dangerous, or expensive to demonstrate in reality.

Instructional Quality/Methodology

General

-#+ Program is useful in an school-based, instructional setting (i.e., a classroom, computer lab, media center, or school library).

#+ Program allows completion of a lesson in one class period (approximately 30 minutes).

\# An on-disk tutorial concerning the program's command structure is provided when appropriate (e.g., for a wordprocessing program).

Appropriateness

-#+ Application is well suited to computer use.

#+ Readability level is appropriate for the intended student population.

Tone of address is appropriate for the intended student population.

The means of response (e.g., single keystroke, manipulating graphics) is appropriate to the intended student population .

Prerequisite skills required are appropriate for the intended student population.

#+ Time required for use by a typical student does not exceed the attention span of that student.

#+ Multiple levels of instruction are available.

Difficulty levels are based on discernible logic (e.g., reading ability, complexity of problems).

#+ Sufficient exposure and practice are provided to master skills.

#+ Sufficient information is presented for intended learning to occur.

Questioning Techniques

Questions are appropriate to the content and effectively measure student mastery of the content.

Questions incorrectly answered can be repeated later in the lesson/exercise.

#+ The number of trials are reasonable and appropriate (e.g., student receives the correct answer after no more than three or four trials, and after at least two trials).

Approach/Motivation

-#+ Student is an active participant in the learning process.

Evaluator's Field Test Results

Student understands the on-screen presentation, and can proceed without confusion or frustration.

Student enjoys using the program.

Program involves students in competition in a positive way.

Program fosters cooperation among students.

Creativity

#+ Program challenges and stimulates creativity.

Program allows the student as many decisions as possible.

#+ Program provides opportunities to answer open-ended questions and provides evaluative criteria to assess responses.

Graphics and Audio

++ Graphics and audio are used to motivate.

++ Graphics and audio are appropriate for the intended student population.

-++ Graphics, audio, and color enhance the instructional process.

++ Graphics help focus attention to appropriate content and are not distracting.

Learner Control

-++ Learner can alter program sequence and pace.

++ Learner can review instructions and previous frames.

++ Learner can end activity anytime and return to main menu.

+ Learner can enter program at different points.

+ Learner can stop in the midst of an activity, and at a later session begin at that stopping point with the previous record of progress intact.

++ Help is available at likely points of need.

Learning Objectives, Goals, and Outcomes

++ Learner objectives are stated and purpose is well defined.

+ For programs requiring use over several days, learning outcomes are worth the time invested.

Feedback

-++ Feedback is appropriate to the intended student population and does not threaten or inadvertently reward incorrect responses.

++ Feedback is relevant to student responses.

++ Feedback is timely.

-++ Feedback is informative.

++ Feedback is corrective when appropriate.

++ Feedback remediates and/or explains when appropriate.

++ Branching is used effectively to remediate.

+ Program uses branching to automatically adjust difficulty levels or sequence according to student performance.

Clarity

-#+ Procedural and instructional statements are clear.

On-screen prompts clearly indicate where user should focus attention.

#+ Frame formatting is clear, uncluttered, and consistent from screen to screen (e.g., screen input is restricted to a consistent location).

#+ Sequence of content topics and instruction is logical and in appropriate steps.

#+ Prompts and cues are clear and consistently and logically applied.

Hints are clear and not misleading (e.g., length of spaces in fill-in blanks matches number of letters needed, incorrect responses are well-chosen).

#+ Demonstrations and examples are clear and available when appropriate.

Interface is simple enough to be used with little or no reading of the documentation.

Prompts to save work are given when appropriate.

Simulations

The time needed to complete both a step and the entire simulation is reasonable

and effective.

Encourages decision-making or calculation rather than guessing.

Teacher Modifiability

-#+ Teacher can easily change or add content.

#+ Teacher can easily regulate parameters (e.g., number of problems, rate of presentation, percentage correct needed for mastery) for each class using the program.

Teacher can easily regulate parameters (e.g., number of problems, rate of presentation, percentage correct needed for mastery) for each student.

Evaluation and Recordkeeping

#+ Program provides an adequate means of evaluating student mastery of the content.

If tests are included, criteria for success are appropriate for the ability/skills of the intended student population.

If tests are included, content accurately reflects the material presented.

#+ Scorekeeping and performance reports are provided for the student when appropriate. (e.g., summary of problems correct/number attempted, running point totals).

-#+ Useful information about student performance is stored for future retrieval.

Useful diagnostic or prescriptive analysis of student performance is available to the teacher, when appropriate.

#+ Student performance information is easily accessible to the teacher.

#+ Program allows printout and screen display of student records.

#+ Program can hold multiple performance records of a single class (e.g., 35-50 students).

Documentation and Support Materials

-#+ Technical and operational explanations for implementation are clear and complete.

If appropriate, "quick start-up" section is included.

#+ Useful reproducible student worksheets are provided.

Content is listed when important or when it would be helpful.

#+ Useful suggestions are provided for introductory classroom activities.

Useful suggestions are provided for classroom activities during the use of the program, where necessary or helpful.

#+ Useful suggestions are provided for follow-up activities.

Useful suggestions are given for classroom logistics in a variety of hardware situations (e.g., single or multiple machines) and student groupings.

#+ Useful suggestions are provided on how to integrate program with the regular curriculum.

If the program is open-ended, subject-specific suggestions are included.

#+ Prerequisite skills are clearly stated.

Accurate and clear description of instructional activities are provided.

Accurate and clear descriptions of content topics are provided.

Quick reference card for program use is included, where appropriate.

#+ Printed text is clear and readable.

Simulations

#+ Description of the model used in the simulation is clear, accurate and complete.

The way variables work are described well.

Technical Quality

++ Audio can be adjusted (i.e., turned down or off).

++ Audio is clear and used effectively.

+ Character sets used in text display are clear, appropriate, and visually interesting.

-++ Graphics are clear and can be easily interpreted.

-++ Program runs consistently under all normal conditions and is "bug-free".

+ Program guards against multiple key presses advancing the student past the next screen (e.g., leaning on return key and thereby missing several screens as they flash by).

++ Random generation or selection is used when appropriate (e.g., to allow repeated use by varying the problems or data presented).

++ Program judges responses accurately and accounts for minor variations in the format of the input (e.g., accepts either the correct word or letter choice in a multiple choice item).

+ Program allows user to correct answers before being accepted by the program.

+ Program accepts partial answers as correct whenever appropriate.

+ Where students must input responses, inappropriate keys are disabled.

+ Control keys are used consistently.

+ Students require a minimum amount of teacher supervision while using the program when appropriate.

+ Operation of computer and peripherals does not interfere with concentration on activity.

+ Program uses other technologies (e.g., audio cassette, videodisc, videotape) to enhance learning when appropriate.

++ Print capability is included, when appropriate.

+ Printing is easy and simple to accomplish with a variety of popular printers.

Start-up and Implementation

Teacher:

+ Start-up time for teacher implementation is not excessive.

+ Teacher needs a minimum of computer competencies to operate program (e.g., does not require installing add-on boards).

Student:

*+ Start-up time for student implementation is brief enough to permit completion of a lesson.

*+ Students need a minimum of computer competencies to operate program (e.g., does not require use of control-key combinations).

Probeware and Peripherals Included in the Software Package

* Probes or peripherals are durable.

* Probes or peripherals are sensitive.

* Audio and/or graphic quality are effective.

* Probes or peripherals are easy to install.

* Calibration is accurate and easy.

* Data displays are flexible (e.g., can be scaled, redrawn).

* Data analysis is useful.

Hardware and Marketing Issues

* Preview copies are available.

* Back-up copies are provided.

* Adequate warranty is provided.

* Telephone support is available.

==========

- Characteristics marked with a dash (-) were included in the forms or guidelines of more than half of the agencies surveyed.

* Characteristics marked with an asterisk (*) were considered important by a group of computer software experts, including teachers, computer coordinators, software publishers, university professors, and software evaluation consultants. Beyond the characteristics specifically noted, many of these experts felt that subject-specific and population-specific characteristics would have to be considered for a thorough evaluation.

+ Characteristics marked with a plus sign (+) were included in the forms and guidelines of more than half of the eight evaluation agencies chosen as the basis for determining "quality software."

APPENDIX V

A SUMMARY OF RESPONSES FROM INTERVIEWS
WITH HEADS OF EDUCATIONAL SOFTWARE EVALUATION AGENCIES
TO ASCERTAIN A PICTURE OF THEIR PROCESSES

To offer a more complete picture of agencies that publish high quality evaluations of educational software, the directors or editors of 11 such agencies were interviewed at length. Eight of these agencies are supported by government funds or private grants; one is a for-profit organization; two publish journals.

Of the 11 participants in this survey, seven have some kind of official affiliation with a larger institution. Four are affiliated with either state or provincial agencies; one has a federal affiliation; one has a university affiliation; and one is affiliated with the National Science Foundation.

GENERAL PHILOSOPHY

Almost three-quarters of the agency directors or editors indicated that they evaluate software for all subjects and student populations. The remaining respondents indicated that they only evaluate software for a specific subject or student population.

Approximately half of the respondents identified local school level personnel as their primary audience. A few said their evaluations were aimed at people involved at all levels of educational software acquisition. Only two respondents mentioned teachers of specific subjects or grade levels.

Surprisingly, recommending software either for purchase or preview was the primary purpose for evaluating software of only a few respondents. The most-often-cited primary purpose was providing information for readers to use as they wish. Subject concerns were mentioned by a few respondents as a reason for performing and publishing evaluations.

When asked if they check with other agencies to see if their evaluations of the same product agree, most responded that they check less than ten percent of the time or not at all. Only two agencies check more than half the time. The most-often-mentioned organizations that they check with are the Educational Products Information Exchange (EPIE) Institute, the Alberta Department of Education, Microsift, the California Technology in the Curriculum (TIC) Project, and the Educational Software Evaluation Consortium's Preview Guide. When checking with another agency, just over half of the respondents felt that their evaluations agreed very frequently.

THE EVALUATION PROCESS

The agency heads were asked a series of questions concerning the evaluation process -- how software is acquired, what is actually evaluated, who evaluates it, and how it is evaluated.

Software Acquisition

To acquire software, the vast majority of the respondents said that they solicit it for free from producers, and that they also accept unsolicited programs. Only a few indicated that they purchase at least some of the software they evaluate.

In order to inform publishers that the agency would accept unsolicited software programs, almost three-quarters said they had sent out an initial mailing to publishers announcing this. Only a few had done any follow-up after this initial mailing.

Of the organizations that solicit or purchase software, the vast majority consult magazine ads and press releases when deciding what software to acquire. Word-of-mouth is used by about half of the respondents, while one third consider the school subject focus of the software. In general, no particular interest was expressed in the products of well-known software publishers.

A slight majority of the respondents indicated that 300 or less different publishers send them programs to evaluate, with the others indicating 100 or less publishers. A few respondents (mostly the editors of journals) indicated that they receive software from 25 publishers or less. These data suggest that many evaluation agencies never see software from a large segment of the over 600 educational software publishers.

Determining What to Evaluate

Who decides which software programs will actually be evaluated? The directors or editors of almost half the agencies either decide on their own or with the recommendation of a staff member. The criteria mentioned most often in deciding which programs to evaluate was that it must fit a specific curriculum objective, content area, or target population, or that trained evaluators with expertise in the specific curriculum area of the software must be available. Almost half the agencies evaluate everything that they acquire.

The only programs that a majority of agencies avoid evaluating are multi-media courses of study that include software (e.g., Voyage of the Mimi, Writing to Read). Programs requiring peripherals not included in the package and not easily accessible are avoided by approximately one quarter of the respondents.

Evaluator Selection and Training

When recruiting potential evaluators, many respondents said they require both teaching and computer experience; others found these qualifications desirable. Almost half require that evaluators be active teachers. Subject matter expertise is required by less than half of the agencies. Only two agencies require either prior experience evaluating educational software or extensive experience using software.

The majority of the agencies train their evaluators, and almost all of these have a standardized training process. Several of the agencies who do not train their evaluators do provide guidelines for filling out the evaluation form. In all, approximately three-quarters have printed guidelines, ranging in length from 2-35 pages.

When training is provided, in most cases it is for five or more hours. Most agencies require only 4 hours or less of supervised practice; the rest require seven hours or more.

Evaluator Assignments

When choosing individuals to evaluate a particular program, the vast majority of agencies use the subject matter expertise of the evaluator as a criterion. Grade level experience and interest in the program's content or focus are also considered.

Most of the agencies surveyed have two or more evaluators work on each program. Almost half use three or more evaluators at least some of the time.

Time Spent by Evaluators

When asked how much time (on average) is spent by each evaluator per program, responses ranged from three to seven or more hours. Time spent by each evaluator actually viewing the program (i.e., not writing up the evaluation report) was cited as three hours or more by half the respondents, with most of the others indicating two hours or less.

Avoiding Evaluator Bias

Agencies were asked if they take any precautions to reduce the chance of bias (e.g., against all drill and practice software or towards a specific teaching approach) in their evaluations. The use of multiple evaluators was the only precaution significantly mentioned.

The Evaluation Instrument

Evaluation forms and/or guidelines were developed from scratch by the majority of the agencies, with the others adapting materials from another agency or agencies.

Those most often mentioned as being involved in the development of the evaluation form and/or guidelines were educational computing specialists. Instructional designers, content area specialists, and teachers were sometimes mentioned. Only a few were able to cite a theoretical basis for their form or guidelines.

Field Testing

Almost half of the respondents indicated that their agencies usually conduct field testing with students in the grade range specified by the software publisher. Approximately half indicated that field testing is rarely or never conducted. Many of these agencies cited the difficulty of setting up field testing situations as the main reason for not field testing.

Most of the respondents reported that the setting and circumstances of the field testing varied greatly from one program to the next, including field testing in the classroom, in a computer lab, and both one-on-one and in small groups at individual computers. Of those who field test, most have evaluators conduct the field testing, and the rest use other classroom teachers. Of those who field test, more than half test on average between 10 and 20 students with each program evaluated, and the others test on average less than 10 students per program. Less than half of those who field test collect any specific data during the field test that they could have made available for us to examine.

Ratings or Recommendations

Ratings or recommendations are given by the vast majority of the agencies surveyed. Almost half give multiple ratings, and almost half give an overall rating. Software is recommended for purchase by some agencies, and a few suggest software to preview. One agency recommends software not to buy.

In deciding on the rating or recommendation, most agencies have the evaluators involved in the final decision. A team leader (sometimes called a *debriefer* or *synthesizer*) is involved by almost half the agencies, and the agency head is involved by some. In one agency, the agency head becomes involved only in the case of unresolved disputes.

In arriving at ratings or recommendations, a majority of the agencies use a set of specific guidelines. A mathematical formula is used by two agencies, those also being users of point scale ratings for various categories. Specific local or state/provincial guidelines are used by two agencies. Of the two agencies having a subject-specific focus, one has subject-specific standards that must be satisfied in order to recommend a program.

WRITING AND EDITING THE FINAL EVALUATION

Who writes the final evaluation? Most agencies use someone other than the original evaluators; some use team leaders with varying degrees of writing experience. Of the eight agencies that assign someone other than one of the evaluators to write the evaluation, the majority have no regular system of meetings between the writer and evaluators.

The copy for the published review is usually edited by the agency head. Professional editors are sometimes used, and generally have expertise in educational computing and have been trained as evaluators.

CONTENT OF THE FINAL EVALUATION

Data Typically Included

Survey participants were asked a series of questions regarding the content of their final evaluations. The following kinds of data are included in all of the agencies' final evaluations.

Components included in the package

Computer family

Cost

Grade or age range

Brief description of the program

The following kinds of data are included by most of the agencies.

Subject

Specific content topics

A clear statement of the software's stated or apparent goals

Type of software (e.g., tutorial, drill)

Thorough description that gives a clear sense of what the user sees and does throughout the program

Some important data were not typically included, such as prerequisite skills, or information about preview policy, backup disks, copy protection, and copyright date.

Issues Typically Addressed

The respondents were asked to identify issues that are addressed in a typical published evaluation, either in a checklist or in evaluative statements. The issues addressed by a majority of the agencies include the following.

Description of the program's strengths and weaknesses

Ease of use/crash proofness (addressed most often as a checklist item)

Recordkeeping

The following is a list of other issues frequently addressed. Issues addressed most often as checklist items are identified with a (C).

INSTRUCTIONAL QUALITY/METHODOLOGY

Overall educational usefulness (C)

Appropriate use of computer technology

Interactivity

Motivation

DOCUMENTATION

Overall quality of the documentation (C)

Inclusion of pedagogic/integration suggestions

TECHNICAL QUALITY

Graphics/character sets

EVALUATION/MANAGEMENT/TEACHER OPTIONS

Teacher can alter content

Many other important issues related to software quality are typically addressed in the final evaluations of only a few agencies (e.g., the ease of integrating a program with the ongoing curriculum, in a classroom setting; user control). Keep in mind that many issues are considered by the evaluators as they complete their evaluation, but are not addressed in the published evaluation.

ACCESSIBILITY TO THE PUBLIC

We asked the respondents a series of questions concerning the accessibility of the published evaluations, focusing on public awareness and use of the service or publication, the number of subscribers, and cost to the consumer.

Public Awareness and Use

Respondents were asked who in the educational community is likely to know about or use the published evaluations. All 11 respondents indicated that local school computer coordinators or media specialists use their service. Most said that small districts (10,000 students or less) use their service, and that large district officials use it. A few indicated that their services are used by State Department of Education officials, local school officials, or college instructors.

A few of the respondents felt that the average local teacher used their service, and almost half thought that the average teacher at least knew about the service. Over half indicated that "leading edge" teachers (the ones who regularly use computers in the classroom and keep up on the latest developments) use their service; a few others said that "leading edge" teachers knew about their service.

Only two of the agencies surveyed had ever conducted a follow-up study to determine who their readers are.

When asked how the public is made aware of their evaluation service, a majority mentioned presentations at conferences and conventions. Almost half mentioned direct-mail advertisements, their own agency's newsletter, and free listings or mention in other publications and newsletters. A few rely on word of mouth. Some evaluations are automatically disseminated to specified sites (usually state-mandated).

Dissemination of Evaluations

The majority of the agencies distribute between 50-150 new evaluations in an average each year. A few distribute more than 150. Professional journals usually distribute fewer than other sources.

When asked how many subscribers they currently have, the majority indicated 5,000 or less.

Cost of the Service

There is no charge for the evaluations from almost half of the agencies surveyed (mostly agencies funded by either state or provincial governments). A few of these agencies do charge out-of-state educators. Yearly subscription rates are in the $20-$25 per year range for about a third of the agencies. Other subscription rates range from $89-$275 per year. Evaluations can be purchased from some of the agencies on a basis other than yearly.

The right to make and distribute copies of the evaluations is included without additional fee by a majority of the agencies. Of the agencies with this policy, most stipulate that the copies cannot be used for commercial gain. Two other agencies will allow copying and distribution rights to be purchased for an additional fee.

APPENDIX VI

A SUMMARY OF RESPONSES FROM INTERVIEWS WITH SOFTWARE ACQUISITION DECISIONMAKERS TO ASCERTAIN THEIR VIEWS ON VARIOUS INFORMATION SOURCES

To ascertain how various sources of information about educational software are used and valued by acquisition decisionmakers, interviews were conducted with 6 representatives of State Departments of Education, 14 representatives of large districts (over 10,000 student enrollment), 10 representatives of small districts, and 12 representatives of local schools (administrators, computer coordinators, and teachers). These interviews were guided by a structured questionnaire that focused on the respondents role in the software acquisition decisionmaking process, the frequency with which respondents use specific software information sources, the usefulness of various kinds of information, and the desirability of certain characteristics of software evaluations. A summary of the responses follows.

RESPONDENTS' ROLE IN THE SOFTWARE ACQUISITION DECISIONMAKING PROCESS

State Education Agencies

When asked what the state's role was in making educational software purchase decisions, four of the six respondents indicated that they evaluate software. California funds the Technology in the Curriculum (TIC) project, which distributes information within the state for free and sells it outside the state at slightly above cost. (However, California state budget cuts may reduce these evaluation efforts.) The other three participate in state consortia, in which each state contributes teachers' time to work on the evaluations and, in some cases, offers course credit for this work. Two of these three publish additional evaluations as part of other affiliations.

Each of the six states has at least one preview center, partially or fully paid for with state or federal funds. California has just dismantled its existing system of independent preview centers and is moving to provide skeletal previewing sites at the county offices.

The states also provide informal, word-of-mouth software recommendations, train teachers to effectively use software, correlate curriculum to software, and negotiate licensing arrangements for software. None of the states publishes a can-buy list.

Large School Districts

Of the 14 large districts surveyed, most conduct evaluations, but many do not publish the results. Instead, they keep the evaluations on file, with some publishing a recommended list. Some conduct evaluations in response to a specific school or content area need. Most large districts operate preview centers. Only a few publish can-buy lists.

Small School Districts

Of the ten representatives of small school districts interviewed, none reported having any formalized district-wide process concerning software acquisition, and indicated that decisionmaking takes place at the local school level. Some small districts conduct informal software evaluation upon request by a school or teacher. In most cases, no central location is available where teachers can come to preview software.

Local School Personnel

Most of the 12 local school professionals said that they make final software purchase decisions and also suggest software products to other teachers or colleagues. Some suggest software products to their supervisors.

INFORMATION SOURCES CONSULTED

State Educational Agencies

Most State Departments of Education representatives said they do not typically require information about specific software programs; when necessary, they rely primarily on catalogues and journals. The vast majority did not judge evaluative information about software as important to their work.

Large School Districts

More than half of the large district respondents reported relying on catalogues, advertisements, recommendations from colleagues and computer specialists, new software listings from popular computing magazines, and publications of the Educational Products Information Exchange (EPIE) Institute (a non-profit, private agency) to obtain information on software.

Less frequently used are professional publications, preferred lists or reviews from local, state, or regional agencies, or reviews from university-based agencies or government-funded agencies. Respondents frequently mentioned that they had no knowledge of reviews from university-based or local, state, or regional agencies. Some found the information provided from local, state, or regional agencies to be outdated by the time they received it.

Small School Districts

Most of the small district representatives reported relying heavily on recommendations from colleagues and computer specialists, and on catalogues.

Less frequently used are advertisements, popular computing magazines, preferred lists or reviews from local, state, or regional agencies, or reviews from professional publications, university-based agencies, government-funded agencies, or non-profit, private agencies. Reviews from local, state, or regional agencies, or from university-based agencies are relatively unknown. Access to reviews from government-funded agencies or non-profit, private evaluations is limited.

Local School Personnel

The majority reported using catalogues, recommendations from colleagues and computer specialists, and reviews from popular computing magazines and professional publications to obtain information about software.

Less frequently used are: advertisements; new software listings from popular computing magazines and professional publications; preferred lists or reviews from local, state, or regional agencies; and reviews from university-based agencies, government-funded agencies, or non-profit, private agencies. Respondents found advertisements unreliable, and often had no knowledge of reviews from local, state, or regional agencies, from university-based agencies, or from government-funded agencies.

PREVIEWING BEFORE PURCHASE

The vast majority of all decisionmakers reported that they preview software prior to purchase. Respondents at the State educational agencies were not involved in previewing.

INFORMATION FOUND USEFUL

Representatives of large districts, small districts, and local schools were asked to rate the importance of various kinds of information about educational software, prior to preview or purchase.

Information considered important by most respondents includes the intended age or grade range, the subject, the type of software, a clear statement of the software's goals, a brief description of the program, and information about the computer family. Approximately half felt that evaluative information was important. Cost information is most important to local school personnel, probably because they make most of the actual purchase decisions and because local school software budgets are relatively small.

OPINIONS ABOUT PUBLISHED EVALUATIONS

The relative unimportance of evaluative information to those surveyed is somewhat surprising. This may be due to the fact that more and more districts and local schools are previewing software prior to purchase; representatives may feel that they no longer have to depend upon the opinions of others. One word of caution here -- our survey sample was extremely small.

In order to further explore the respondents' concerns about published evaluations, when respondents indicated that evaluative information was somewhat important, they were asked the extent to which they agree with a set of statements concerning evaluations.

Most of the respondents felt that evaluative comments should be based on a stated, well-defined set of criteria, that comments should be based on a consensus of the opinions of two or more evaluators, that teachers and content experts should be among the evaluators, and that field testing in a classroom setting should be part of the review process. They also wanted evaluations that describe the program's good and bad points, assess the seriousness of any problems, and discuss the instructional implications of the program's good and bad points. Also considered important was a discussion of the quality and importance of the print documentation and supporting materials. Most were willing to spend 10 minutes or less reading an evaluation about a single software program.

Most of the representatives from small school districts and local schools also wanted reviews that compare the software program under review with other, similar programs. These educators generally have access to fewer software programs than representatives of large districts, since small district personnel and local educators have less access to preview centers.

APPENDIX VII

LICENSING AND LEASING, FIELD TESTING, AND PREVIEWING

The 750 software publishers whose products are ' ..uded in the analysis of educational software presented in Chapter I of this study were surveyed* as to:

- ways of acquiring a product other than purchase (e.g., licensing arrangement, leasing)
- whether products are field tested
- provisions made for preview of products before purchase

It is estimated that between 600 and 700 of the publishers produce instructional programs for grades K-12. There is no way to select out the survey responses of only those publishers.

LICENSING AND LEASING

Of the 750 suppliers surveyed, only 25 (3%) responded to questions about the availability of leasing and licensing arrangements. Of the 25, 13 reported offering licensing arrangements. It is significant that the vast majority of software publishers surveyed did not respond to questions about licensing and leasing. Industrywide, there exist both great interest and concern over the licensing and leasing of software. We suspect that many publishers have no set policies, while others are just forming such policies.

Data presented at two recent computer conferences (NECC and Microtrends), reveal that some companies offer site licenses on some of their products, but not all. Many companies with site licensing policies have had them in effect for less than a year.

Site licensing can mean very different things to different producers. To some it means unlimited copying rights. When some publishers refer to site licenses, they, in fact, mean a method of heavy discounting (e.g., computer packs, lab packs, classroom packs), with no provision for unlimited copying. Some companies sell the right to duplicate a certain number of disks and put a counter on the original disk so that it will only make that many copies. For some, the network version of a software program constitutes a site licensing agreement, since more than one computer station can use the software at the same time. Furthermore, an important question being asked throughout the industry is how to define a site. Is it a building? A computer room? A classroom?

The International Communications Industries Association (ICIA) has recently published a booklet entitled, *Copyright: Practical Guide to Licenses.* In it ICIA general counsel, Stephen Strauss, expresses the view that school systems, in their adoption of educational software, should be purchasing multiple copies of programs instead of single copies.**

---

* Educational Products Information Exchange (EPIE) Institute, The Educational Software Selector (Water Mill, NY: Unpublished, in-house database version, 1987).

** Stephen Strauss, Copyright: Practical Guide to Licenses (Fairfax, VA: International Communications Industries Association, 1987).

In recognition of the need of some software publishers to develop site licensing arrangements, the ICIA included a sample Courseware Duplication Agreement and a sample Courseware Networking Agreement. In both of these sample agreements, the issue of copying rights for supplemental print materials was raised. In the sample agreements, the licensee would have received only one set of print materials and would have had to purchase additional sets from the software publisher. Thus the issue of site licensing has two components: the right to copy and distribute the software, and the right to copy and distribute the print materials.

FIELD TESTING

Of the 750 suppliers surveyed, 25% (188) offered information regarding their field testing. Of those 188 responding, almost all (174) reported that they field test their products. These 174 represent 23% of all the suppliers surveyed. Some suppliers (51) specifically stated that field testing is done in schools or classrooms.

Other forms of evaluation, including in-house testing, evaluation by content experts, and review by authors and developers, were reported by only 14 of the 188 respondents.

PREVIEW POLICY

Of the 750 suppliers surveyed, more than half (424) provided data on their preview policy. Of the respondents, 240 (57%) stated that they do permit potential customers to preview their products before purchase. Conditions for previewing varied.

Most companies require written requests on school stationery or requests that are accompanied by a purchase order. Of the 240 that permit previewing, 59 reported no time limit on the preview period, with 171 stating a time limit. In most cases (150), suppliers offer previewing for a period of 30 days, although the range is from 10 days to 3 months. Some of the 30 day trials (30%) are offered as "money back guarantees."

Ten publishers make their products available for preview through school districts, regional or local resource centers, or through educational associations.

Of the 424 respondents, 28% (119) report offering no preview opportunity. Many of these (114) offer instead a demo disk, a program sampler, or product documentation or manuals, in some cases, for a small fee. Keep in mind that a demo disk or sampler can be designed to present only the most positive aspects of a program.

An additional 65 of the software publishers surveyed stated no specific previewing policy, but rather refer potential customers to local dealers, retailers, or sales representatives, and in one case to CompuServe.

BIBLIOGRAPHY

Bialo, Ellen R., "Market Trends in ESL/Bilingual Software," unpublished typescript, New York, NY, July 1987.

Carnegie Corporation of New York, Carnegie Forum on Education and the Economy, The Task Force on Teaching as a Profession, A Nation Prepared: Teachers for the 21st Century (New York, NY: May 1986).

Education Turnkey Systems, "Microcomputer Use in Special Education," unpublished summary, 1987.

Educational Products Information Exchange (EPIE) Institute, *The Educational Software Selector (TESS)*, unpublished database version, (Water Mill, NY: July, 1987).

The Holmes Group, Inc., Tomorrow's Teachers (East Lansing, MI: April 1986).

International Software Database Corporation, *.MENU -- The International Software Database*, an online database, (Fort Collins, CO: 1987).

The National Commission on Excellence in Education, A Nation at Risk: The Imperative for Educational Reform (Washington, DC: United States Department of Education, April 1983).

National Governors' Association, Center for Policy Research and Analysis, Time For Results: The Governors' 1991 Report on Education (Washington, DC: August 1986).

The National Task Force on Educational Technology, Transforming American Education: Reducing the Risk to the Nation (Washington, DC: United States Department of Education, April 1986).

R.R. Bowker Company, *The Microcomputer Software and Hardware Guide*, an online database, (New York, NY: 1987).

San Diego State University, National Origin Desegregation Assistance (Lau) Center, Educational and Societal Futures: Meeting the Technological Demands of the 1990s (San Diego, CA: 1984).